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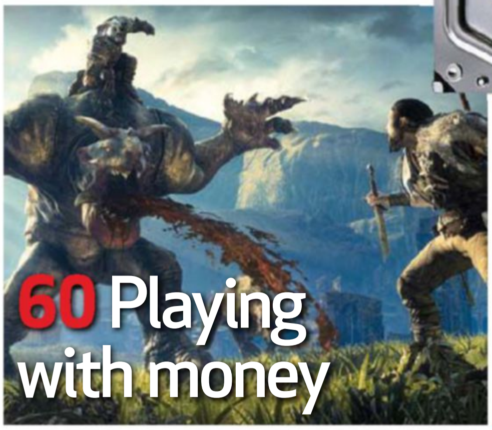
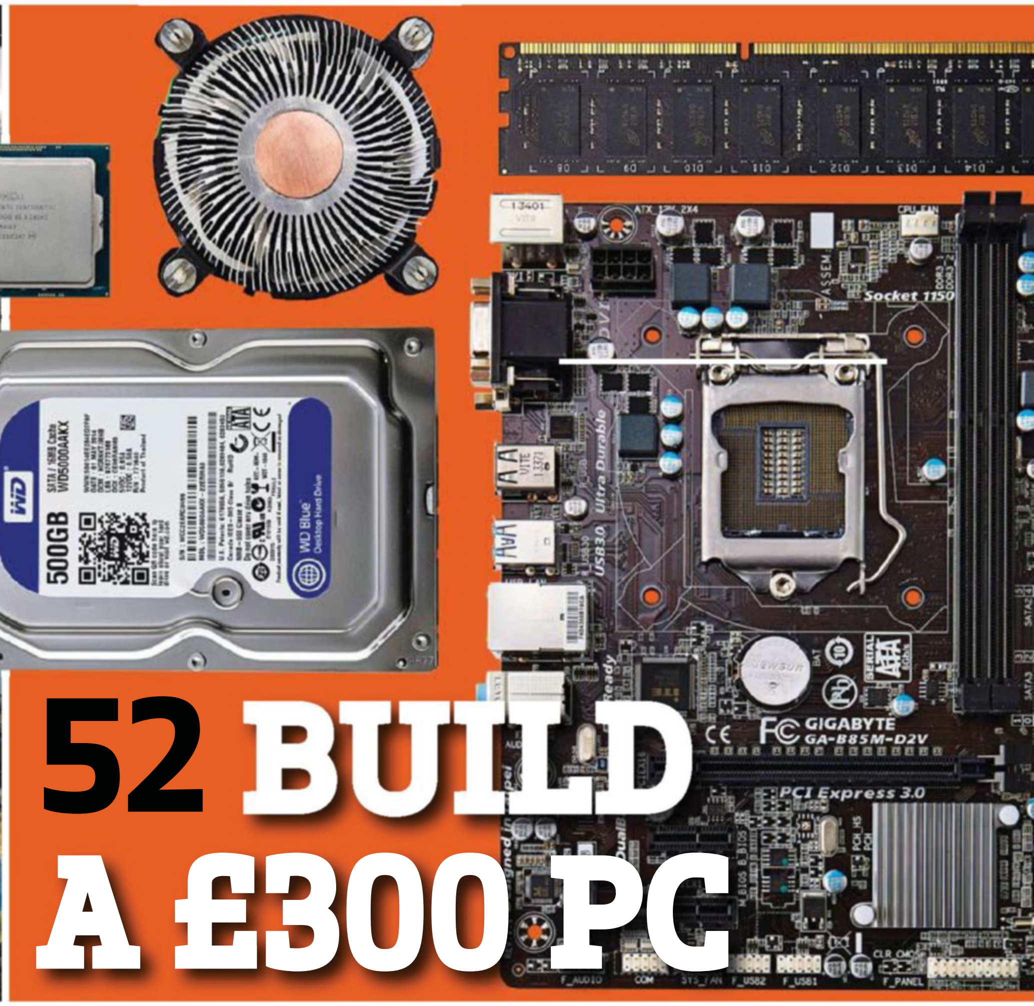
PCFormat #300/01.15

Contents

08 Picking the perfect panel



60 Playing with money



52 BUILD A £300 PC

Featuring…

12 Monitor grouptest
Picking the perfect panel isn't easy, that's why we've grabbed a selection of different screens for you.

52 Build a £300 PC
For less than the price of a new games console you can build a 1080p gaming rig.

60 Playing with money
How much we pay for our games, and the ways we do it, are constantly changing.

Hardware reviews…

24 **Sapphire** R9 290X 8GB Vapor-X
26 **Gigabyte** P35X v3
27 **OCZ** ARC 100 240GB
28 **Syber** Vapor I
30 **Chillblast** Fusion Assimilator
32 **Scan** 3XS Z97 Performance Q10
34 **Samsung** XP941
36 **Crucial** Ballistix Sport DDR4 2,400MHz
37 **Lacie** Little Big Disk Thunderbolt 2
38 **Asus** RoG Gladius
39 **Gigabyte** Raptor
40 **Asus** STRIX Pro
41 **Creative** SB Inferno
42 **MSI** GTX 970 Gaming 4G / **Gigabyte** GTX 970 G1 Gaming
43 **Asus** GTX 970 STRIX OC Edition / **Zotac** GTX 970 AMP! Extreme

INSIDE HARDWARE

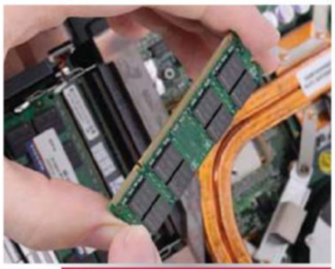
INSIDE GAMING

26 Gigabyte P35X v3

27 OCZ ARC 100 240GB

30 Chillblast Fusion Assimilator

34 Samsung XP941



78 How to be a tech guru

66 Far Cry 4

72 Dragon Age: Inquisition

Hotwired…

78 How to be a tech guru
Luis Villazon lets us in on the tricks of the tech guru trade and helps us solve any PC problem ourselves.

86 Homebrew your own NAS

90 Back up with File History

Regulars…

44 Rig Builder
48 Subscriptions
92 Ask Luis
98 Voice of Reason

Gaming reviews…

66 Far Cry 4
68 Assassin's Creed Unity
70 Call of Duty: Advanced Warfare
72 Dragon Age: Inquisition
74 World of Warcraft: Warlords of Draenor
76 Football Manager 2015

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See page 48 to find out how to save…

A brief history of (my) time

Luis Villazon is PC Format's longest-serving contributor. This entitles him to pontificate

Three hundred issues is a *lot*. Don't be fooled by other large numbers such as the number of protons in the universe (10^{79}) or the highest score in *Temple Run* (136 million). Protons are tiny and *Temple Run* is easy. Making a magazine is hard, and nobody lasts at it for long. Except for me. I have written for *PC Format* since issue 46 and presided over Ask Luis since issue 47. In my time at *PC Format*, I've watched the PC go from something that only tinkerers have, to a mainstream consumer item, and then back to something that only tinkerers have (now that most people make do with the tiny screen on their phone or the huge one in their living room). I used Windows when it was just a flat interface with applications rigidly tiled together, and watched it evolve into a 3D stack of translucent panes and then back into a flat interface with applications tiled together. But some things never change. The graphics card is still the most important component; we still manage to run out of RAM; the internet is still too slow; network printing is still a nuisance to set up.

In 1995 we gave away a book on PC maintenance with the magazine. I wrote about half of it. In the troubleshooting section, I advised readers to try starting Windows in standard mode by loading it with "WIN /s" at the command prompt. That's right – Windows wasn't something you booted – it was something you ran, as an extra interface layer on top of the text-only DOS operating system. And standard mode wasn't like today's safe mode. It just forced the processor to emulate the Intel 286 CPU, instead of the 386 and 486 chips that most of us were using.

PCs used to break a lot more back then. For a while we devoted the January issue every year to fixing the new computers that Santa had brought our readers. In 1997, we printed the first incarnation of the PC Troubleshooting flowchart that you may have heard me refer to. In 1998 we restyled it as a game of snakes and ladders (mostly snakes). In 2000 it became a Cluedo murder mystery. And then in 2001, I tested the pre-release version of XP and wrote about how it never crashed. I didn't think people would still be using it 13 years later though, and Microsoft certainly didn't. (When Win95 was released, I told everyone to wait for Win96 – boy, that was a long three years.)

The PC has changed a lot in 300 issues, and so has the magazine. But the sort of person who reads the magazine hasn't changed nearly so much. We PC enthusiasts aren't the kind of people who want things to 'just work'. We want to push them farther than they are supposed to be pushed and make them do things that they were never designed for. Sometimes we push too far and they just *don't* work. But that's part of the process too. You can't tell where the line is, if you don't cross it occasionally. And the next time you are shouting in frustration at your uncooperative box of wizardry, I want you to remember how far we've come. So here's something I wrote in 1995: "If you have 4 megabytes or less of RAM, consider upgrading to 8Mb. Depending on your motherboard configuration, this will cost around £120." ■

> "For a while we devoted every January issue to fixing the new computers Santa had brought our readers"

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We've come a long way in 24 years, but it's still good to look back...

Ever wonder how it all started? What this fine magazine looked like when it was first unleashed on the world? Well, this issue you can find out exactly what it looks like, because we're giving away a digital version of the magazine for anyone that wants to step back in time some 300 issues and a not-inconsiderable 24 years. Everything from the adverts for £200 Soundblaster soundboards through to cutting-edge game reviews of the likes of *Gunship 2000*. You can download your own copy from the PC Format iOS app or from Zinio (www.zinio.com). We wish you a delightful trip down memory lane. ■

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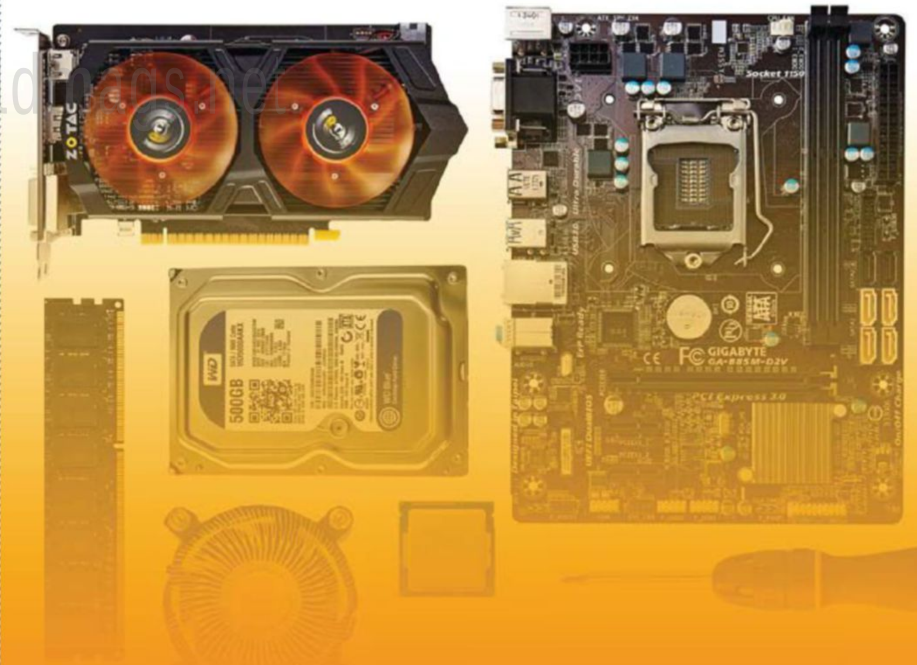


CELEBRATING IN STYLE

The only way to celebrate turning 300 is to build a £300 gaming PC

Three hundred issues. Twenty four years. Over 22,000 pages covering the wonderful world of technology, equating to something like 13 million words on our favourite subject. That's an incredible body of work, and a great achievement for this humble magazine. Few manage to get to the point where the issue number rolls over to the big 300. But that's exactly what all of us have managed (and that includes anyone who has ever bought the magazine).

You only have to look back at the first issue to see just how much technology has moved on. Indeed, that's something you can do right now, because we've made the first issue available for free using the wonders of modern technology (well, maybe not that modern, but it's still free).

Back in issue one we gave readers a chance to win an external CD drive reader package worth no less than £400. The adverts are a well of information as well. Guess how much a 20MHz, 80386-powered Zenith PC with 2MB of memory, 60MB hard drive and VGA 640 x 480 screen would set you back? How about a cool £1,000? Yeah, and that was actually a pretty good deal for the day.

Just to put that first issue in some kind of gaming perspective, the reviews are of *Secret Weapons of the Luftwaffe* and *Gunship 2000* – PCs were already seen as the best way to experience flight simulators, although as a sign of things to come, *Speedball 2* also makes an appearance. The shareware section is home to a review of one *Commander Keen* as well, from a small company that went on to do some big things: Id Software.

To highlight just how far we've come in that time, this issue we've set ourselves the task of building a £300 PC that is capable of playing the latest games. This isn't a rig on which you'll have to ease back on all the settings in order to hit smooth framerates at 1080p, either – there's surprising power in this little rig.

It is of course overclocked, although don't be put off by that; we'll guide you through exactly what you need to do, and we haven't even plumped for any kind of exceptional cooling – just the stock unit that ships with the CPU itself. To get going, turn to page 52 and get ready to build an impressive machine that won't break the bank, just people's preconceptions. The fact that this machine will give consoles a good run for their money is just the icing on the cake.

There are plenty of other great articles in the issue too, including a feature on how the way we pay for games has changed, which screen should be the top of your wish list, how to solve any PC problem, a round-up of the best GeForce GTX 970 cards right now, plus reviews of the latest hardware and games. It's a great issue, I hope you enjoy it. Here's to the next 300!

Alan Dexter
Editor
alan.dexter@futurenet.com

THE SEARCH FOR THE PERFECT PANEL

DAVE JAMES HAS BEEN ON THE HUNT FOR THE IDEAL PC MONITOR, EYEBALLING UMPTEEN SCREENS IN THE HOPES OF FINDING THAT ELUSIVE PERFECT PANEL

Your expensive graphics card only really comes into its own when you're playing an intensive 3D game, your processor only when it's chewing through more maths than an evening with Vorderman, and your pricey ol' SSD only when you're copying the (entirely legitimately-obtained) complete works of *Breaking Bad*. Your monitor, though, is in full use whenever you boot up your PC, and a good screen will make everything from games to movies to web pages look better.

That makes it one of the most important parts of your PC setup, though it generally gets short shrift when it comes to thinking about where to spend your valuable upgrade cash. But spending big on a quality screen will see you right not only for the life of your current machine, but likely for a good few iterations to come.

The perfect example is the screen we've had attached to the testing rig since our Dexter was in short trousers. The geriatric 30-inch Dell 3007WFP is almost ten years old now and still looks glorious, even alongside the latest 4K screens we've been testing. Sure, it was a frightening amount of cash at the time, but it's outlasted every PC platform since 2005.

But you don't have to spend thousands to pick up a panel that will stand the test of time. There are a host of quality screens available at the moment, catering for pretty much anything you'd do with your PC.

What we want, though, is that perfect monitor. The monitor that can be everything to all people; be a great gaming screen, a marvellous movie display and a precise productivity panel. We've got a selection of ten different screens, but can any of them claim to be the perfect panel?

GEAR REVIEWED

Acer
XB280HK
p12

AOC
G2460PG
p12

AOC
U3477Pqu
p13

Asus RoG
Swift PG278Q
p13

BenQ
GW2765HT
p14

Iiyama Prolite
B2888UHSU
p14

Iiyama Prolite
GB2773HS
p15

Samsung
SD850
p15

Viewsonic
VG2401mh
p16

Viewsonic
VG2438sm
p16

This glorious ol' Dell is so old it still thinks Bioshock is a new-fangled game…

To figure out what would constitute the perfect panel we need to look at the various technologies on offer at the moment and in the future, and what they look like in actual screens you can buy. For the longest time, it was purely about getting any flatscreen with a 1080p native resolution. That 1,920 x 1,080 res has been the standard ever since the consoles started their somewhat-abortive journey towards full high definition. Before that we all thought 1,680 x 1,050 screens were pretty neat…

Of course we did have higher resolution screens available, but they were ridiculously expensive (like our Dell) and demanded a level of rendering power that our graphics cards couldn't manage on their own at the time. Those times are changing quickly, though, and while a full third of the contributors on the Steam Hardware Survey are still running 1,080p primary desktop resolutions, that's becoming a downward trend. Prices on 2,560 x 1,440 screens are dropping in price and the graphical horsepower required to drive that resolution is getting cheaper all the time.

It also helps that TV manufacturers are really trying to drive home the message that resolution is important again. Now everyone's got their 1080p HDTV, and the manufacturers have finally given up on this iteration of 3D, they're trying to push new television sales with the new 4K carrot. That's great for us, mainly because we're such utter high-resolution snobs, but also because it helps drive down prices across the board with increased panel production and consumer demand.

A sign of four

Just in case you've been protesting against climate change on Bondi beach for the past few years, 4K is four times the resolution of 1,080p (3,840 x 2,160) and is also the new buzzword for the gaming and graphics card marketing guys too.

As much as that super-high resolution can be quite stunning it's most definitely not without its flaws – the primary one being that you effectively need an utterly massive screen to really be able to do it justice. Even the 28- and 32-inch 4K panels seem too small to allow you to run the screen without needing your OS to scale up a bit; the icons and text are simply too tiny to avoid migraine eye-strain. Unfortunately in Windows that scaling is still far from an ideal solution. With a 40-inch panel size, though, like Philips' upcoming 4K screen, you'll get the same sort of pixel pitch as a 1,440p screen – and that should mean no more OS scaling. Whether 40 inches actually works on a desktop is debatable – we'll enjoy finding out…

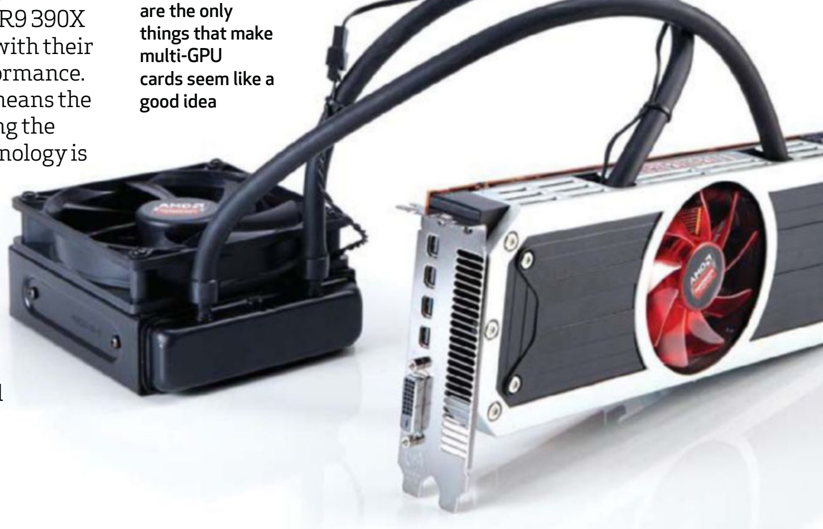
> “A SCREEN RATED AT 1MS IS EITHER A TN PANEL, OR SOMEONE IS FIBBING”

The other problem with 4K is that to be able to power such a screen in-game you really need a multi-GPU solution, and that's not normally something we feel comfortable recommending. Even Nvidia's GTX 980 struggles at that res and the AMD 290X's chunky new 8GB frame buffer doesn't help either. Fingers crossed the upcoming GTX 980Ti and R9 390X will have more of chance with their increased rendering performance.

But resolution is by no means the be-all and end-all of picking the perfect panel: screen technology is also a serious biggy. There are really only three basic types of panel tech we're interested in: twisted nematic (TN), vertical alignment (VA) and in-plane switching (IPS). TN used to be all you could find in a normal monitor, especially if it was being aimed at PC gamers. The benefits of TN is that it's a very mature technology so it's relatively cheap to produce, and it also allows for quick shifts in pixels, giving it a high response time. If you see a screen rated at 1ms then it's either a TN panel or someone in the marketing department is fibbing.

The big downside is that the colour reproduction on a TN monitor is generally pretty weak and washed out, and you'll also get seriously poor viewing angles. The angle at which a viewer sits in relation to a TN screen determines what they see on screen. That can mean variations in colour and shade, and in extreme examples it can almost look like it's displaying the negative image.

The vertically-aligned screen tech was introduced as a competitor to IPS and comes with excellent viewing angles and in particular incredible contrast. That



4K resolutions are the only things that make multi-GPU cards seem like a good idea

Nvidia's G-Sync hardware puts a pretty premium onto compatible screens

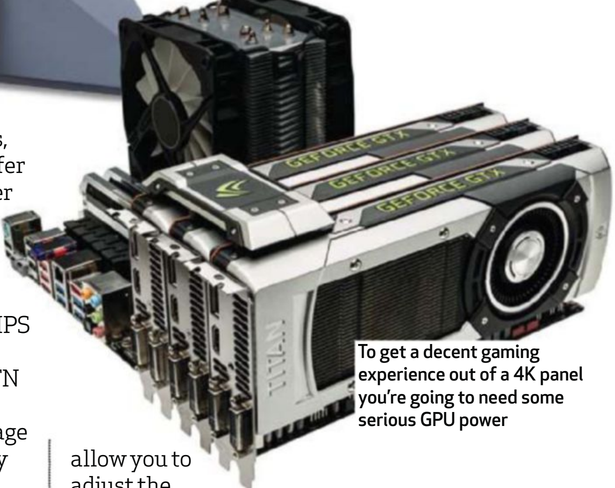
means if you're into your inky blacks, VA screens are the best. They also offer higher response rates than the slower IPS panels, though not quite up to TN levels. The downside is that they can have some ghosting or input lag issues.

For us, though, the pinnacle is the IPS panel. IPS screens may not have the response time of a gaming-focused TN display, but they're really not far off. Colour reproduction and general image quality is why you go for IPS, and why Apple did for its Retina tech. The viewing angles are always impeccable, which makes it perfect for tablets and phones, but the downside is they require bright backlights, which can make the contrast weaker than VA.

Perfect panel tech?

So, for our money, we're all about IPS tech; that would have to be in our perfect monitor. But, while we've been very down on TN screens in the past, the latest twisted nematic panels in the affordable 4K range have been much improved. Their improved viewing angles and colour reproduction are seriously impressive, making those latest big screens mighty tempting for super-high-res gaming.

A high-res IPS screen, though, would seem to be the perfect choice for our ideal monitor. There are still a few things standing in the way of that – not least our penchant for high-refresh-rate screens. It's quite tricky to get across just how much of a difference moving up from 60Hz to 120-144Hz can make, even on the Windows desktop. The extra level of smoothness it adds to movement is something you'll immediately notice. It's not just on the desktop it matters either; many games allow you to adjust the refresh rate and *Elite: Dangerous* in particular looks stunning at 144Hz. Both Nvidia and AMD have their own spins on this tech – check out 'Screen Sync' for more.



To get a decent gaming experience out of a 4K panel you're going to need some serious GPU power

The final piece of the puzzle is your screen's aspect ratio. The original 16:10 widescreen ratio quickly gave way to the shallower 16:9 because of the prevalence of 1,080p displays, but we're starting to see more ultra-widescreen panels doing the rounds.

We initially thought the 21:9 aspect ratio was a bit of a joke. When the first 29-inch models tipped up with the super-shallow 2,560 x 1,080 native res they delivered a frustrating experience on the desktop, but what the extra width added to gaming gave a tantalising glimpse of its potential. Now we've got 34-inch panels with a 1,440 pixel vertical height – great on the desktop and stunning in-game.

The perfect panel must surely be a 144Hz, IPS, 34-inch 21:9 panel with some sort of GPU synchronising technology. Sadly that combination of the crown jewels of monitron doesn't exist, so we're going to have to compromise. Stick around – we'll find the right monitor for you… ■

Screen sync

Nvidia's G-Sync technology kicked off the battle for screen and GPU synchronisation, offering a way to ditch tearing in-game without the telltale stutter that accompanies enabling VSync. "What stutter?" you may ask. It's funny what we become used to without even noticing – it wasn't until seeing G-Sync in action that we really understood what it offered. The difficulty is that it can then be jarring going back to a non-synchronised screen. Spoiled, you have been…

The reason you get tearing in a game is that your monitor is not getting frames from the GPU at the same time as it's ready to present them to you. Your average 60Hz screen will refresh its panel sixty times every second; if your GPU isn't delivering them precisely at that rate, incomplete frames are supplied to the monitor and displayed, which appear as tearing. VSync aims to solve that by buffering frames, but that introduces its own slight stutter.

Nvidia's G-Sync adds proprietary hardware to compatible monitors to allow the GPU and panel to talk. The GPU will thus only deliver complete frames when the screen is able to display them. That way you get no buffering, no stuttering, no tearing – just baker's-custard-smooth gaming.

But this extra proprietary tech adds extra cost because of the licensing fees Nvidia levies for G-Sync to be used. This closed system is something AMD is railing against with its open-source FreeSync technology. FreeSync is a similar idea to G-Sync but works by utilising the Adaptive Sync part of the next version of DisplayPort – 1.2a. FreeSync-compatible monitors won't need any extra hardware, with all the FreeSync goodness being in the GPU itself – making them cheaper than G-Sync equivalents.

Currently only Hawaii and Tonga-based cards from AMD will be compatible with FreeSync screens when they debut at the start of 2015, but with a new range of Radeons surely on the way, the future of PC gaming sure is looking smooth.

£500 28-INCH 4K

ACER XB280HK

VITAL STATISTICS

Price £500
Manufacturer Acer
Web www.acer.co.uk
Panel size 28-inch
Native resolution 3,840 x 2,160
Panel tech TN
Refresh rate 60Hz
Pixel response 1ms
Inputs 1x DisplayPort
G-Sync Yes

The first 4K screen we saw was Asus' hulking great 32-inch £4,000 behemoth. It was a bit lovely, with a stunning IGZO IPS display, but the pricing was, and still is, quite staggering. Thankfully we've quickly seen prices tumble for 4K monitors and that's thanks to the new TN panel now being used by many manufacturers.

But, before you skip the rest of the review in disgust at the merest mention of some twisted nematics, this is a new generation of TN panels, better than we've seen before.

The 28-inch panel in this Acer screen is as good as any we've seen in the affordable 4K range. It offers impressive colour reproduction and viewing angles; meaning you'd actually have to spend a good while with this panel to figure out it's not a budget IPS screen. It's genuinely that good. The vertical viewing angles are where the disparities between TN and IPS are most stark, but if it's positioned properly on your desk that shouldn't be an issue for a solo user.

What the XB280HK has that no other 4K monitor we've seen can offer is that little slice of G-Sync hardware inside. The Acer cannot offer the 144Hz refresh of other G-Sync panels, but given the demands of a 4K resolution that's not such an issue for the screen-syncing tech in-game. Therein lies the difficulty with a 4K G-Sync monitor though – to get the most out of it you really are going to need a beefy ol' Nvidia graphics array inside your PC.

But if you're an Nvidia-gamer looking to upgrade to a 4K screen, the Acer is almost a no-brainer given that you're pretty much getting G-Sync for free. It's a modern TN panel with impressive image quality – though we still have our reservations with 4K screens of this size. ■

PCFormat Verdict

Features	★★★★½
Performance	★★★★☆
Value	★★★★☆

A good value 4K screen, with the added bonus of G-Sync for those with the rendering power.

★★★★☆

£320 24-INCH 1080p

AOC G2460PG

VITAL STATISTICS

Price £320
Manufacturer AOC
Web www.aoc-europe.com
Panel size 24-inch
Native resolution 1,920 x 1,080
Panel tech TN
Refresh rate 144Hz
Pixel response 1ms
Inputs 1x DisplayPort
G-Sync Yes

Now, we're not saying at £320 this AOC screen is cheap, but it's still the best value G-Sync screen we've found. You might, quite reasonably, baulk at the idea of paying over £300 for a 24-inch TN panel; this isn't 2005 after all. But this is actually one of the best TN screens we've tested in recent times, almost up there with the latest 4K TNs.

When you put it side by side with the super-expensive RoG Swift, you can instantly see the difference in panel quality. There is almost none of the tell-tale washed-out look most other non-4K TN screens have. The colour reproduction is excellent, with deep, vibrant colours and seriously impressive black and white levels too. This is genuinely a good panel, and not just a good TN panel.

The only place where you will see the inherent problems with using TN technology is in the G2460PG's viewing angles. They're typically poor, meaning that only the person sat directly in front of the screen is going to be able to get the most out of this otherwise excellent monitor. As a gaming screen, though, that's not much of an issue when most multiplayer PC fun is done over the interwebtubes, not in split-screen or suchlike.

At 24 inches it might feel a little cramped if you're used to larger panels, but the 1080p native resolution and 144Hz refresh rate complements the G-Sync tech perfectly. The lower res means you don't need to have a super-powerful graphics card to get the full benefit out of the res/refresh combo and still achieve smooth gaming performance.

We're seriously impressed with this monitor, surprisingly so. It's by no means cheap, but for a panel of this quality it's really not a bad price when you consider what else is on offer in terms of G-Sync. ■

PCFormat Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★☆

This is a surprisingly good TN panel offering super-smooth gaming at the 1080p level.

★★★★½

£600 34-INCH 1440p

AOC U3477PQU

VITAL STATISTICS

Price £600
Manufacturer AOC
Web www.aoc-europe.com
Panel size 34-inch
Native resolution 3,440 x 1,440
Panel tech IPS
Refresh rate 60Hz
Pixel response 5ms
Inputs 1x DisplayPort, 1x HDMI, 1x DVI-D, 1x VGA
G-Sync No

At the risk of this test coming across like a huge AOC love-in, we're going to have to admit this U3477Pqu is one of our favourite monitors. Ever. We've seen few more dramatic screens in our time, especially when it comes to our favourite PC pastime of gaming.

We'd previously been caught up with the idea of super-high 4K resolutions being the next step in monitor progression. That was before we realised there were few tangible benefits to offset the massive rendering power demands they suddenly introduced. The 21:9, 34-inch panel, however, delivers a more dynamic and immersive experience, which a 'mere' 4K resolution simply cannot offer.

For a start the IPS panel, with its 3,440 x 1,440 native resolution, looks absolutely stunning. It's as sharp as you could wish, with rich colours and impeccable viewing angles – which is vital given the width of the damned thing. We're used to having to spend time fiddling about with the settings of an out-of-the-box AOC to get it looking right, but this beautiful screen was drawing crowds without us needing to do anything.

Partly that's because any game or other media at this aspect ratio looks so much more dramatic than anything else. The best part of the 21:9 ratio is that, sitting directly in front of the 34-inch panel, it almost entirely fills your field of view. That draws you much further into the game than a weedy 16:9 ratio does. There are still issues with some games not working, but see last issue how Flawless Widescreen can fix those.

The only real issue we have with this AOC screen is that £600 price. It feels far too high given that its 4K panel is a little less than £400 – but boy, it really is exquisite. ■

PCFormat Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★☆

A stunning-looking monitor, in terms of both panel and aspect ratio, but the price is huge.

★★★★½

£629 27-INCH 1440p

ASUS SWIFT PG278Q

VITAL STATISTICS

Price £630
Manufacturer Asus
Web http://rog.asus.com
Panel size 27-inch
Native resolution 2,560 x 1,440
Panel tech TN
Refresh rate 144Hz
Pixel response 1ms
Inputs 1x DisplayPort
G-Sync Yes

By any definition of the word, this monitor is most definitely Swift. Far too often we get products with stupidly obtuse names, so it's enormously refreshing to see Asus with a relatively simple, descriptive name for its excellent screen.

The lightning-fast, 27-inch Swift was the first 1ms panel with both support for G-Sync and a 144Hz refresh rate at such a high resolution. That's pushing it as close as it seems possible to currently get to the perfect PC gaming monitor.

But it's by no means the perfect panel. In fact the biggest disappointment with the Swift is the TN screen inside that slim, well-designed chassis. Compared with the modern TN panels in the 4K monitors in this test, or even that 24-inch AOC, the Asus screen is noticeably of a lower quality. The colours have that classic TN washed-out look and the viewing angles are really quite poor too. The white saturation levels of the Swift are also rather weak as well, meaning you'll lose some definition in brighter scenes.

Thankfully the rest of the monitor pretty much makes up for the panel's deficiencies. The 144Hz refresh rate, paired with G-Sync and the 1440p resolution, makes it a fantastically smooth monitor in-game. The washed-out feel all but disappears once you're immersed inside a fluid, responsive gameworld. That resolution does demand a fair degree of rendering power to achieve, but nowhere near as much as 4K.

If you're thinking about spending north of £600 on this screen, however, you'll no doubt already be rocking some serious performance hardware. The struggle we have is that it's still a £600 TN screen, and not a very good one at that. Recommended for gamers with a powerful Nvidia GPU only. ■

PCFormat Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★½☆

The panel itself is of old-school TN stock, but the impressive feature set makes up for a lot of its failings.

★★★★½

£275 27-INCH 1440p

BENQ GW2765HT

VITAL STATISTICS

Price £275
Manufacturer BenQ
Web www.benq.com
Panel size 27-inch
Native resolution 2,560 x 1,440
Panel tech IPS
Refresh rate 60Hz
Pixel response 4ms
Inputs 1x DisplayPort, 1x DVI-D, 1x HDMI, 1x VGA
G-Sync No

Over the past few years a 27-inch IPS monitor with a 2,560 x 1,440 native resolution would have been the pinnacle of PC screenery. Now we're looking enviously up at the super high-res 4K screens, or the glorious 34-inch 21:9 panels of AOC's U3477Pqu for our aspirational displays. That's a very good thing, though, as it means you can pick up this quite lovely BenQ monitor for less than £300.

However good the new 4K TN panels get, or how much manufacturers try and talk up the inky blackness of a good VA screen, there is always a sense of relief switching back to the vibrant colours of an IPS monitor. That's certainly been the case during testing this month; sparking up this BenQ feels almost like coming home – to a vibrant desktop displayed without the TN wash-out or flaky colouring.

This BenQ is rocking a classically good-looking IPS panel, with great colours, decent blacks and outstanding white saturation. The only issue we have with the panel itself is that it does suffer ever so slightly from input lag when placed next to something like the lightning-quick RoG Swift.

Despite the impressive price there's little evidence of the GW2765HT chasing the budget crowd. The chassis has a slight wobble to it, but it's rocking a full tilt/swivel stand and all the relevant (and at least one irrelevant) inputs. The shiny plastic chassis does lend it a slightly outdated, mid-naughties look, but the bezel doesn't really detract from the excellent panel BenQ has used. It's also sporting the now-familiar BenQ OSD, dynamically displaying each option on-screen beside the relevant button.

For less than £300 this really is an impressive IPS screen, well worth the dosh. ■

PCFormat Verdict

Features	★★★★☆
Performance	★★★★½
Value	★★★★½

A great value monitor with a lovely, high-res IPS display that makes this a tough one to beat.

★★★★½

£420 28-INCH 4K

IIYAMA B2888UHSU

VITAL STATISTICS

Price £420
Manufacture Iiyama
Web www.iiyama.com
Panel size 28-inch
Native resolution 3,840 x 2,160
Panel tech TN
Refresh rate 60Hz
Pixel response 1ms
Input 2x DisplayPort, 2x HDMI, DVI, VGA
G-Sync No

Say what you like about TN panels, but they've made 4K monitors genuinely affordable. The telling part of this test is that the 4K screens aren't the most expensive displays in this whole round-up – in fact they're a long way off it. That's most evident in this excellent screen from Iiyama, which is one of the best 3,840 x 2,160 monitors we've seen.

At just £420 the Prolite really is exceptional value for a 4K screen, and that doesn't imply any quality reduction either. The modern TN panels used for these affordable super-high-res screens are the best examples of this cheaper display tech. The contrast levels and colour reproduction are genuinely hard to distinguish from a 6-bit IPS panel, and that's pretty high praise for TN. Out of the box, this Iiyama screen shows that image quality from the off.

It doesn't feel like a cheap monitor either. The chassis isn't going to win any GQ style awards, but the functional black surround is solid and functional. The bezel isn't particularly thin, but neither is it offensively chunky. What are slightly offensive are the touch-sensitive buttons. They don't feel at all sensitive and the lack of tactile feedback, coupled with their slight delay, makes them a bit frustrating.

Our usual 4K reservations remain, mostly around OS scaling issues and the amount of rendering power these panels demand for gaming. This Iiyama doesn't have the benefit of the rival Acer's G-Sync tech, but then only 50% of PC users are sporting Nvidia cards. Of those, an even smaller percentage have cards capable of driving such a beastly resolution. For the rest of us, particularly the productivity crowd, this great-value Iiyama should be the 4K screen to aim for. ■

PCFormat Verdict

Features	★★★★☆
Performance	★★★★½
Value	★★★★½

The image quality is as good as is possible with the 4K TN panel and the price is genuinely affordable.

★★★★½

£246 27-INCH 1080p

IIYAMA GB2773HS

VITAL STATISTICS

Price £246
Manufacturer Iiyama
Web www.iiyama.com
Panel size 27-inch
Native resolution 1,920 x 1,080
Panel tech TN
Refresh rate 144Hz
Pixel response 1ms
Inputs 1x DVI-D, 1x HDMI, 1x VGA
G-Sync No

Chasing an ever bigger display is generally what people are looking for in a screen upgrade. Normally a larger display will come with a higher resolution, which can be either a blessing or a curse depending on how much raw graphical horsepower you've got nestling inside your gaming PC.

Productivity types have no real worries when it comes to picking up a monitor – even today's CPU-based graphics can cope with up to 4K resolutions on the desktop. Gamers, on the other hand, need to know their cards can cope with the rigours of eye-searing resolutions.

That's why the maker created 27-inch panels still sporting a GPU-friendly 1,080p native resolution. The maker in question here is Iiyama and it's produced a big-screen monitor which gives you the dramatic scale of a more expensive panel without the usual graphical demands.

The problem is that it's done so with a classically ropey TN panel. It's not as washed-out as the otherwise excellent RoG Swift, but the white saturation is utterly appalling, and so are the viewing angles. We've seen 27-inch, 1,080p IPS screens from the likes of AOC which have a far superior chassis and colour reproduction for considerably less than this Iiyama monitor.

What this screen does have, and what almost makes it worth suffering that TN tech for, is a smooth 144Hz refresh rate. It's the cheapest of the high-refresh-rate monitors in the test and that means it's worth a little more consideration, but realistically that alone can't save this screen. The pixel pitch isn't a massive issue despite stretching of the 1,080p res across a large display, but the blown-out whites mean we can't recommend it. ■

PCFormat Verdict

Features ★★★★☆
Performance ★★★☆☆
Value ★★★½☆

The cheapest 144Hz monitor in the test, but even that can't redeem it from poor image quality.

★★★½☆

£460 32-INCH 1440p

SAMSUNG S32D850

VITAL STATISTICS

Price £460
Manufacturer Samsung
Web www.samsung.com
Panel size 32-inch
Native resolution 2,560 x 1,440
Panel tech VA
Refresh rate 60Hz
Pixel response 5ms
Inputs 1x DisplayPort, 1x DVI-D, 1x HDMI
G-Sync No

Experience has taught us that if there's a problem with a Samsung monitor it's not going to be anything to do with the actual panel. Samsung makes some of the finest screens we've ever used - provide panels for a few other manufacturers, including the displays in the Oculus Rift.

It was incredibly disappointing, then, when we plugged in this hulking 32-inch monitor only to be met with a damned ugly panel.

Sure, it's bright and the colours are pretty good for the most part, but the real problem is in the viewing angles. Given that this is a VA panel, that's a big surprise. Traditionally VA has been superior to TN in practically every way bar the pixel response and refresh rate, so for this screen to be so far off the pace in terms of image quality is bizarre. The *most* bizarre part is that even when you're sat in the supposed sweet spot directly in front of the monitor, the image quality is worse than when you're looking at it sidelong. That's inverse to the situation with TN screens, and rather odd.

The standard Samsung build quality seems to have taken a break too, as the chassis is not up to its normal high standards. The angular look of the bezel won't be to everyone's tastes, but it's the painfully sharp edges where the joins are that make it feel a mite shonky. Then there's the seriously wobbly stand. If you don't have it in a vice-like grip while you're clicking the control buttons, they're impossible to use. It also suffers from a bit of input lag compared with the better screens on test.

None of that makes us think this large display is in any way worth the £460; the image quality of the cheaper Iiyama 4K makes it far superior. ■

PCFormat Verdict

Features ★★★½☆
Performance ★★½☆☆
Value ★★☆☆☆

A surprisingly weak monitor from traditional panel-kings Samsung. Best given a wide berth.

★★½☆☆

£250 24-INCH 1080p

VIEWSONIC VG2401MH

VITAL STATISTICS

Price £250
Manufacturer Viewsonic
Web www.viewsoniceurope.com
Panel size 24-inch
Native resolution 1,920 x 1,080
Panel tech TN
Refresh rate 144Hz
Pixel response 1ms
Input 1x DisplayPort, 1x DVI-D, 2x HDMI
G-Sync No

Viewsonic has dropped a really impressive little 24-inch display into its VG2401mh. It is still a TN panel, but one of the better we've seen in recent times. It's not quite on the same level as the top-of-the-range TN screens used in the affordable 4K monitors, but it's on a similar plane of existence to the AOC G-Sync.

That means while it does still have the washed-out look of traditional TNs, the colours are actually pretty good and the contrast and black levels are excellent. The white saturation is still a bit of an issue for this Viewsonic screen, but only really at the high end when you knock the brightness back a notch or two. The horizontal viewing angles are also rather impressive for a TN panel, though the verticals are typically poor. We're also not fans of the oddly smudged red go-faster stripe on the chassis, nor the fact it takes a full 12 seconds to wake up, but those are minor concerns against image quality.

The VG2401mh has the same 144Hz refresh rate as the 24-inch AOC, but lacks a G-Sync module for the full Nvidia gaming experience. That's what the extra £70 gets you with the G2460PG, so really this Viewsonic is best considered against the 27-inch Iiyama screen. They're both about the same price with a native 1,080p res and 144Hz refresh, but the Iiyama has an extra three inches in size.

That makes the monitor itself bigger, which should also make it more dramatic in-game – but there's still something to be said for 24-inch HD panels. The image quality in general is just better with this Viewsonic screen, but when you've also got a tighter pixel pitch with the smaller panel size it looks even more crisp. We'd much rather have this smaller monitor. ■

PCFormat Verdict

Features	★★★★☆
Performance	★★★★☆
Value	★★★★☆

A quality 24-inch HD panel with that silky-smooth 144Hz refresh, and only minor TN issues.

★★★★☆

£220 24-INCH 1200p

VIEWSONIC VG2438SM

VITAL STATISTICS

Price £220
Manufacturer Viewsonic
Web www.viewsoniceurope.com
Panel size 24-inch
Native resolution 1,920 x 1,200
Panel tech IPS
Refresh rate 60Hz
Pixel response 5ms
Input 1x DisplayPort, 1x DVI-D, 1x VGA
G-Sync No

Well, this is a rarity: a modern 16:10 monitor. That taller aspect ratio is almost as rare as the burgeoning 21:9 ratio. Viewsonic's latest screen is sporting a 24-inch IPS panel with a 1,920 x 1,200 native resolution, though at this size it's almost like giving a dwarf Cuban heels.

The trouble with the added height is that on a 24-inch panel, measured across the diagonal, it seem a little squeezed at the sides compared with a standard 1080p 24-incher. When you're using it on the Windows desktop that's not an issue, as the added height allows for more useful information to be displayed on screen at once than a shallower panel. In-game, though, this size feels a little too limited for the 16:10 aspect ratio.

That's probably why Viewsonic is marketing this as a productivity monitor. In addition most monitor manufacturers don't want to call an IPS monitor a gaming screen because they can't win the war of numbers when it comes to the pixel response timings or refresh rate. But IPS is still our favourite screen tech when it comes to image quality, though there's something a little off about the panel in the VG2438sm – it's a little dark.

The subdued tones of the screen – even at 100% brightness – make it look like you're permanently viewing the panel through dark glasses. That in turn means the contrast and black levels are relatively poor at the lower end and the colour reproduction also suffers, lacking vibrancy or depth.

It's a shame the 16:10 ratio is so poorly represented, as we still love the 2,560 x 1,600 res of our 30-inch Dell monitor. At this smaller size it doesn't quite make as much sense. ■

PCFormat Verdict

Features	★★★⯪☆
Performance	★★★⯪☆
Value	★★★★⯪

A good value screen at the increasingly rare 16:10 ratio, just lacking a little zest in the panel's tone.

★★★★☆

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	Acer XB280HK	AOC G2460PG	**AOC U3477Pqu**	Asus RoG Swift PG278Q	BenQ GW2765HT	Iiyama Prolite B2888UHSU	Iiyama Prolite GB2773HS	Samsung S32D850	Viewsonic VG2401mh	Viewsonic VG2438sm
Retail price	£500	£320	**£600**	£630	£275	£420	£246	£460	£250	£220
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Panel size	28-inch	24-inch	**34-inch**	27-inch	27-inch	28-inch	27-inch	32-inch	24-inch	24-inch
Native resolution	3,840 x 2,160	1,920 x 1,080	**3,440 x 1,440**	2,560 x 1,440	2,560 x 1,440	3,840 x 2,160	1,920 x 1,080	2,560 x 1,440	1,920 x 1,080	1,920 x 1,200
Panel technology	TN	TN	**IPS**	TN	IPS	TN	TN	VA	TN	IPS
Refresh rate	60Hz	144Hz	**60Hz**	144Hz	60Hz	60Hz	144Hz	60Hz	144Hz	60Hz
Pixel response	1ms	1ms	**5ms**	1ms	4ms	1ms	1ms	5ms	1ms	5ms
Inputs	1x DisplayPort	1x DisplayPort	**1x DisplayPort, 1x HDMI, 1x DVI-D, 1x VGA**	1x DisplayPort	1x DisplayPort, 1x HDMI, 1x DVI-D, 1x VGA	2x DisplayPort, 2x HDMI, 1x DVI-D, 1x VGA	1x DVI-D, 1x HDMI, 1x VGA	1x DisplayPort, 1x DVI-D, 1x HDMI	1x DisplayPort, 1x DVI-D, 2x HDMI	1x DisplayPort, 1x DVI-D, 1x VGA
G-Sync	Yes	Yes	**No**	Yes	No	No	No	No	No	No
Score	★★★★☆	★★★★½	★★★★½	★★★★½	★★★★½	★★★★½	★★★½☆	★★½☆☆	★★★★☆	★★★★☆

AOC
Gold
PCFormat
Gold

AND THE WINNER IS…

AOC U3477PQU

But only just. In fact this has been the toughest test when it comes to finding a definitive 'winner'. There is no perfect monitor at the moment and the reason for that is that, after a period of relative stagnation, we're seeing panel tech advancing quicker than it has in a long while.

That means there are a host of different screens tipping up, each offering interesting new technology, or combinations of technologies, but none offer what we consider the perfect package.

Essentially the key battle is between the Asus RoG Swift PG278Q and the AOC U3477Pqu – a battle between a super-speedy, smooth panel and an incredibly beautiful, dramatic one. We've been batting this back and forward in the office since we started this test. These are the two best screens we've tested; each of them offer something the other doesn't, but each also has its drawbacks.

Were we measuring a monitor's greatness on its gaming prowess alone then the Asus screen would get the nod. It's got some of the finest screen tech available, making your gaming experience as smooth and detailed as it could possibly be, but only so long as the supporting graphics hardware is a) powerful enough and b) made by Nvidia. It's the combination of the 144Hz refresh rate and the G-Sync technology that makes the Swift such a good gaming screen. Add in the fact it's the only screen available with that refresh rate and a 1440p native res, and you've got a one-of-a-kind monitor. The downside is that the panel is a TN, and not a great example of TN-kind either. It's also painfully expensive.

The AOC on the other hand can't claim either G-Sync or a 144Hz refresh rate, but what it does have is that immensely immersive 21:9 aspect ratio. If your game supports it, the U3477Pqu can fill your field of view, drawing you further into the game than a standard 16:9 can. It's also got an absolutely stunning 34-inch IPS display, with crisp, vibrant colours and impeccable viewing angles. It's not just a winner in-game, either, as it is arguably even better for use on the general OS desktop.

Again though you will need a fairly beefy GPU to drive the 3,440 x 1,440 native resolution in-game, and it's almost as expensive as the Swift. We do miss the 144Hz smoothness and, with a 5ms pixel response, some would baulk at using it as a gaming screen too. There are also slight issues with finding fully 21:9 content to display on it as well. But it's a more versatile screen than the Asus and that superwide IPS panel certainly wont disappoint, from the moment you free it from its box.

AOC have another little winner in this test too, with the G2460PG. At £300-odd it is rather pricey for a 24-inch TN panel, but it's a good TN, and also runs at 144Hz, with G-Sync and all at a 1,080p native res.

> "IT'S A TOSS-UP BETWEEN THE ASUS AND AOC BIG BOYS"

Iiyama's bargain 4K and BenQ's well-priced 1440p IPS both deserve a mention too for the productivity-focused crowd. But still, for the win, it's a toss-up between the Asus and AOC big boys. We're going to have to stop now before we change our minds again… ■

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PC GAMER
EDITOR'S CHOICE
★★★★★
HEXUS
PERFORMANCE

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Hardware

Performance gear, uncompromising verdicts

WHAT ARE YOU DOING, DAVE?

"Console gamers are starting to feel the pain of being a PC gamer without any of the real benefits"

Dave James will by now have made it through Christmas, finding himself estranged from his fiancée and kittehs throughout the 'holiday period'. But, to be fair, that's mostly down to his being resolutely stuck in a space-based fantasy world of his own choosing. Yup, *Elite: Dangerous* is finally complete and sucking away people's time… well, Dave's time, at least.

The PC ruined Christmas. Grinches rejoice! We managed to make all the new games released around the holiday period an absolute nightmare. Hell, we even got *World of Warcraft* onto the BBC's self-righteous shoutgasm, *Watchdog*. Not only that, we totally ballsed up the consoles. Where once they were the bastion of simple gaming pleasures, they're now as oblique and frustrating as the worst days of wrestling with MEMMAKER.

That's our fault – because part of our history as PC people is putting up with things not working. As much as we like to extol the virtues of the PC as a perfectly versatile platform, I guarantee you will have had to deal with a metric crapload of arsing-about in order to get things working in the past. Whether it's something like a corrupted driver, a hardware compatibility issue with a new game or just a b0rked operating system update, we've gotten through it and stoically soldiered on with nary a complaint. Well, not a lot of complaining. Not officially, or anything like that.

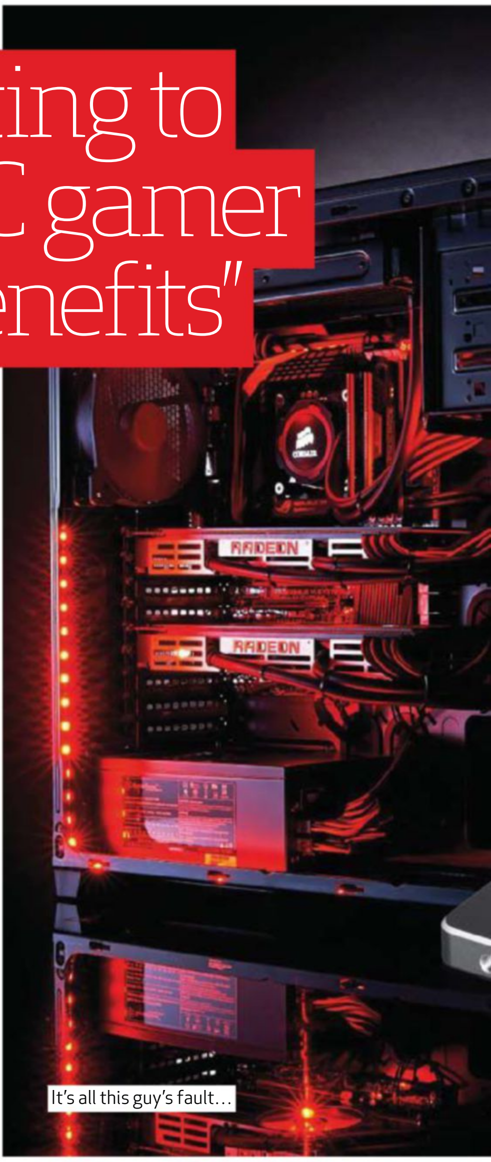
Because we have accepted games released with problems on certain configurations of the rainbow array of different PCs people own, because we've blithely accepted that patching is a completely necessary and understandable part of gaming, the publishers now assume *everyone* will. The holy broken trinity of *Assassin's Creed Ubity*, *Far Cry 4* and *Dungeons of Draenor* have caused great consternation with their post-release b0rks. That means console gamers are starting to feel the pain of being a PC gamer without any of the real benefits, or even the vague reward of occasionally actually fixing a problem yourself. They're given all the problems but none of the tools.

It's a harsh reality and, to be fair, we *were* right to accept that things aren't always going to work first time, simply because my PC is completely different to your PC and your mate's PC and your mum's PC, etc. On the consoles, though, that's different. Your PS4 or Xbox One is exactly the same as anyone else's. There shouldn't be undiscovered, or logistically undiscoverable, bugs in games released on the consoles – they're closed platforms, so the publishers and devs know exactly how a title plays the moment they get final builds.

But, as has happened with PC gamers, the world at large is quite happy to move on. Sure, those games didn't work straight away, with the pre-orders and day one purchasers rewarded with a stint as an unpaid wing of a publisher's Q&A team – but they're still going to sell a boat load. What's more, a month down the line the wounds have largely been salved, and we all get to play the games they should have been at launch and forget what we were whinging about in the first place.

So the cycle continues. Sorry, everyone.

P26
GIGABYTE P35X V3



It's all this guy's fault…

FLAC to be a Win 10 native

Microsoft has recently announced that support for the Free Lossless Audio Codec (FLAC) will be native to the next release of Windows. The codec allows for audio files to be compressed to around half their size without losing fidelity in decompression – it's completely lossless.

This is great news for audiophiles as it shows that there's even greater media support in Windows 10, which in turn means that every application will now be able to take advantage of that FLAC support.

It's shaping up to be a very tasty consumer OS, as Microsoft has also announced support for MKV files out of the box too – in much the same way as the Xbox One currently supports them.

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Would we buy it and should you buy it? That's all you want to know and it's all we care about. Performance and value for money are the two key pillars supporting the mighty *PC Format* Gold Award on its lofty pinnacle.

ZALMAN: RUMOURS OF OUR DEMISE…

Last November it was reported that PC cooling company Zalman was facing bankruptcy because of a serious fraud investigation ongoing with its parent company, Moneaul.

Zalman itself, though, has released a statement with the classic "rumours of our demise have been greatly exaggerated" vibe. A Korean court ruling has absolved Zalman of any responsibility or liability for the fraudulent behaviour of its parent company. That does mean, however, it will now have to go it alone and stand on its own two feet.

As such, Zalman isn't out of the woods by any stretch of the imagination, but its affairs are more under its own control. The statement also details that existing or future customers need not worry as all Zalman warranties will continue to be honoured in full. "Zalman will always guarantee post-purchase support to our customers," Min Park, Zalman's President said.

EDITOR'S ONE TO WATCH

3D NAND: SSDs are the next war

This new year will see the SSD war really hotting up, as Intel and Micron have teamed up against Samsung in the battle of 3D NAND. The past year was a relatively quiet one in terms of SSDs; sure, we had the first stirrings of M.2, but none were the proper NVMe offerings that we really need to shift performance up a gear. Things will change in 2015, though, as we'll start to see SSDs built to take advantage of the PCIe connection from the ground up. But speed isn't the only thing that's going to change; we're also set for some seriously capacious new drives too.

Thanks to the work Samsung, Intel and Micron are doing with memory technology we'll also start to see capacities increase because of the introduction of 3D NAND. Like the stacked RAM that's coming to graphics memory, NAND silicon is being built on top of one another, linked through the layers with billions of pillars.

Samsung was first to the punch in 2014 with its Samsung 850 Pro and 850 EVO, just on sale as this issue goes to press. Its 32 layer NAND comes in MLC densities of 86Gb and TLC densities of 128Gb. The partnership between Intel and Micron is set to produce MLC and TLC densities of 256Gb and 384Gb respectively. That makes for dies with 32GB and 48GB capacities. The South Korean giant isn't going to sit on its laurels, though, and is expected to bring a new generation of its V-NAND tech to market in the second half of 2015. We expect to see some seriously high-capacity goodies at its SSD Summit.

Having such high-density NAND modules means the companies will be able to produce much higher capacity SSDs at affordable prices. Intel even expects that this tech will allow for 10TB SSDs within the next couple of years.

The big SSD guys aren't the only ones making the switch: Toshiba has started work on moving its 2D NAND fab in Mie, Japan to 3D NAND production and is expecting to see shipping products in 2016.

SAMSUNG
Solid State Drive

Samsung started the V-NAND ball rolling last year

Captain Jack to set sail at Computex?

There have been some tantalising rumours doing the rounds about the next generation of graphics cards from AMD. Some quote purported specs for the upcoming Pirate Island GPUs, and those numbers are pretty staggering. The top Bermuda core (R9 390X) is reported to have some 4,224 stream processors in the full chip and the second tier Fiji (R9 380X) with a still-chunky 3,072.

Interestingly a leaked benchmark shows a 'Captain Jack' preview test card running some 10% quicker than a GTX 980. The really fascinating part, though, is that it's not far off the efficiency too. According to rumours we may only see the cards at CeBIT in March, with a Computex/June release.

But will it be 20nm?

HIGHLIGHTS THIS MONTH

24 Sapphire R9 290X Vapor-X 8GB

30 Chillblast Fusion Assimilator

34 Samsung XP941

Vapor-X
SAPPHIRE
B0241

£390 GRAPHICS CARD

SAPPHIRE R9 290X VAPOR-X 8GB

What's the best way to deal with competing GPUs? Play the numbers game

VITAL STATISTICS

Price £390
Manufacturer Sapphire
Web www.sapphiretech.com
GPU AMD Hawaii XT
Stream processors 2,816
Core clock 1,030MHz
Memory capacity 8GB GDDR5
Memory clock 5,500MHz
Memory bus 512-bit

Right now we're still a while away from having AMD's next-generation graphics cards hitting our test beds. That means the only red-tinged competition for Nvidia's latest Maxwell cards are the old Hawaii-based GPUs. So, what's a manufacturer to do?

Well, you either drop your pants on price or you start trying to tweak your existing technology to make a bit more of a fight of it. As it turns out AMD has done both: slashing the old prices and now encouraging its partners to release the likes of this, the suped-up 8GB R9 290X from old hands Sapphire.

The reasoning runs thus: Nvidia's GTX 980 rules the roost at standard resolutions, but things get mighty tight between the standard R9 290X and the GTX 980 when you start moving up the resolution scale towards 4K. Part of this is down to the memory configurations the two graphics cards are rocking. Nvidia has gone with a relatively low-rent 256-bit bus to go alongside its 4GB GDDR5 memory, and AMD has been sticking with a full 512-bit bus for its high-end cards. Nvidia claims its funky new memory compression algorithms help give it a push in terms of memory bandwidth, but that doesn't seem to help up in the thin air of the 4K summit.

AMD has then decided to really hammer home the advantage its aging GPUs have in terms of their memory bus, upping the frame buffer to this huge 8GB capacity. With high-res 4K games flinging texture and geometry data at GPUs like adolescent bonobos with bodily waste, AMD is hoping the extra capacity will give the R9 290X the push it needs to cement its place as *the* 4K gaming card.

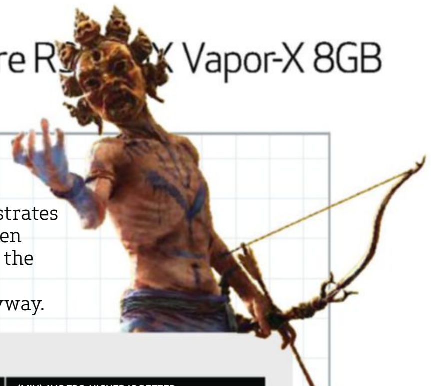
That's the theory, but how much are today's games limited by the memory capacity, and how much are they being bottlenecked by either the rendering performance of a GPU or the memory bandwidth available to it?

Moar gigs

First off though, what's in this here Vapor-X card? Sapphire has already released a 4GB version of this R9 290X Vapor-X and there are precious few real differences between the cheaper, older card and this latest version. The most obvious one is the extra 4GB of GDDR5 memory Sapphire has added to the board. Bizarrely though, for a more expensive, third-party cooled version, Sapphire has dropped the clocks on both GPU and the memory setup.

Where the original 4GB Vapor-X was running at 1,080MHz out of the box – only a modest boost over the 1,000Hz reference clocks – this memory-heavy version is operating at only 1,030MHz under load. It's a similar situation with the memory clocks too; the 4GB card's memory is pegged at 1,410MHz while this 8GB offering sits at 1,375MHz. Considering this is meant to be the current flagship of AMD's graphics card range, the drop in clockspeed is a bit odd.

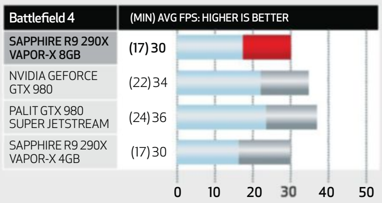
In addition, because we're still working on the old Hawaii XT GPU we're still talking about Graphics Core Next 1.1. The extra bandwidth AMD has conjured up for its most recent GCN 1.2 Tonga GPU, using

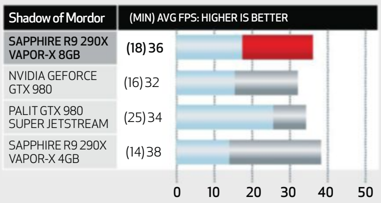


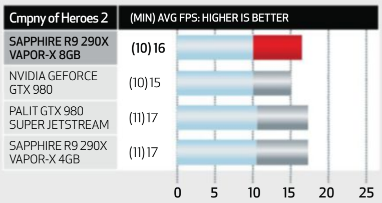
Technical analysis

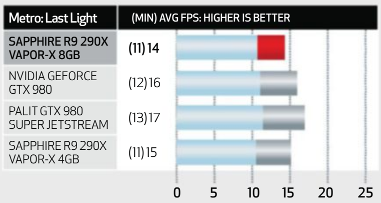
All of our tests were run at 4K Ultra settings, and this demonstrates how the extra rendering power of the GTX 980, especially when overclocked, can make up for its memory deficiencies. Where the 8GB Vapor-X does either gain parity or an advantage over the Nvidia cards, the 4GB Vapor-X invariably pulls ahead of it anyway.

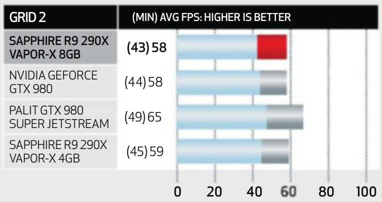
DirectX 11 gaming performance



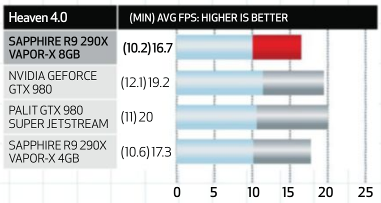








Synthetic tessellation performance



similar lossless compression techniques to Nvidia, are therefore not available to the 8GB Vapor-X. So really it's only a boost in overall capacity, not memory performance, and given its frame buffer is running with a lower clockspeed, is that enough?

Getting testy

To get a bead on what the extra-size frame buffer offers we've tested the new Vapor-X card against its 4GB forebear, as well as the reference and overclocked GTX 980 cards from Nvidia and Palit respectively. We've also tested them all in a variety of titles and at different resolutions.

In the vast majority of cases all this testing has proved the current GPU manufacturers have been right to stick with 4GB of VRAM for their high-end consumer graphics cards. This 8GB Vapor-X isn't far behind the more expensive Nvidia cards when it comes to the very highest resolutions, and when put up against the stock-clocked GTX 980 the AMD card often takes the lead.

In *GRID 2* and *Company of Heroes 2* at 3,840 x 2,160, there is nothing between them, and in the more modern *Shadow of Mordor*, with its high-res textures, the AMD card is most definitely quicker. Where it does lag behind the GTX 980, it's only a couple of frames per second on average short of pace, in *Total War: Rome 2* and *Metro: Last Light*.

That would seem like vindication for the power of the extra frame buffer, but it's not the boosted capacity of the video memory which gives it that performance lead. The increased available bandwidth provided by the 512-bit memory bus enables the R9 290X to deal with the extra data a 4K resolutions demand, but it's the exact same case with the 4GB Vapor-X card too.

> “WHERE IT DOES LAG BEHIND THE GTX 980, IT'S ONLY BY A COUPLE OF FPS”

Because of that cheaper card's higher clockspeed you're also getting higher frame rates out of it than the 8GB version. That all puts the lie to the increased capacity actually being of any tangible benefit. If you want faster performance at higher resolutions, 4GB is fine; you just need more bandwidth and more rendering power.

AMD knows this, which is why the upcoming Fiji XT GPU to go in the R9 390X, in the first half of 2015, is likely to ship with a 4GB frame buffer. It will, though, be using high bandwidth memory (HBM), with the chips stacked on top each other, attached by through-silicon via (TSV) connections to provide insane amounts of memory bandwidth. Rumours are that we potentially looking at a 4,096-bit bus.

All this means the £70 premium for this 8GB Vapor-X is simply not worth it. The higher-clocked 4GB card is quicker across the board, and an overclocked GTX 980 still keeps the lead for Nvidia because of the Maxwell GPU's rendering power. The price drops on the standard and overclocked R9 290X cards makes them interesting options for the high-resolution crowd, but you're still going to need a pair of cards to get decent gaming performance at 4K, and a pair of cheaper GTX 970s is going to give you that.

So, very much like the bottom-end cards of yore that traded needlessly on high VRAM numbers, this all smacks more of a marketing concern than offering anything that's actually going to benefit you. Sapphire's Vapor-X is still a great cooler and it makes for a worthy graphics card – but it doesn't make sense to be charged more for unnecessary extra memory. ■ **Dave James**

PCFormat Verdict

Features	★★★★½
Performance	★★★★☆
Value	★★½☆☆

Classic R9 290X performance, but slower than the cheaper 4GB Vapor-X, rendering it mostly unnecessary.

★★★½☆

£1,599 GAMING LAPTOP

GIGABYTE P35X V3

Rivalling desktop graphics is tough for any notebook, but in a thin 'n light?

VITAL STATISTICS

Price £1,599
Manufacturer Gigabyte
Web www.gigabyte.com
CPU Intel Core i7-4710HQ
GPU GeForce GTX 980M
Memory 16GB
Storage 240GB SSD, 1TB HDD
Screen size 15.6-inch
Native resolution 2,880 x 1,620
Dimensions 270 x 20.9 x 385mm
Weight 5.5kg

When Nvidia pulled the wraps off its GeForce GTX 980M mobile graphics chip, the internets burst alive with much rejoicing; at last, here was a laptop GPU that could give the best desktop graphics cards a run for their money. Well, kinda.

Make no mistake, the 980 looks mega on paper. With 1,536 Maxwell-style shaders and a baseclock north of 1GHz, the 980M is one hell of a GPU by any metric, including the desktop. What it's not is unique in history. In fact, to reach what's arguably the golden age of laptop gaming you have to wind the clock right back to 2005 and the GeForce Go 7800 GTX, a mobile GPU with the same number of pipes and shaders as the fastest desktop graphics of the day.

In that context, we're actually disappointed that the 980M doesn't have all 2,048 of its shaders switched on. The 980M is based on the same GM204 chip as the desktop 980, but lacks 512 shaders.

That minor point aside, we can introduce the vehicle for our first taste of the 980M, Gigabyte's P35X v3. We've seen the P35 before, of course, and all of what we previously liked remains. It's impressively thin and light for such a powerful mobile rig. Likewise, Gigabyte has done a decent job keeping the power brick non-presposterous in terms of proportions, especially since the P35 houses a quad-core Intel Core i7-4710HQ chip too.

It's the quad-core CPU du jour for this kind of lappie and none the worse for it. With a baseclock of 2.5GHz and a maximum Turbo speed of 3.5GHz, it has more than enough performance to deliver on the P35's gaming core competence. That it also delivers nearly four hours of HD video playback on battery power is pretty nice, too.

Screen play

Where this system differs from P35s passim is the screen. It's a glorious IPS panel with 2,880 by 1,620 pixels. Immediately, we're worried about overkill. After all, this is a 15-inch mobile rig: surely 1,080p is plenty – and don't forget about Windows traditional resolution scaling f-wittery. But here's the thing; the ultra-dense pixel grid doesn't just get close to making anti-aliasing redundant, it also means non-native resolutions look less blurry and interpolated.

That's intriguing because, although the 980M makes an incredibly good fist of gaming at that ludicrous 2,880 by 1,620 pixel native resolution, for truly smooth frames rates you're going to either need to play without anti-aliasing or drop down to 1,080p.

Our one major worry is heat management. For starters, this notebook is offensively loud in-game when the fans spool up. We also doubt how long this system can realistically manage the high GPU temps. The Heaven benchmark was reporting 85 degrees out of the box and it's not at all unusual for laptops to develop cooling problems over time. The P35's thinness and lightness looks great at first, but may end up being a long-term liability. ■ **Jeremy Laird**

PCFormat Verdict

Features	★★★★★
Performance	★★★★★
Value	★★★☆☆

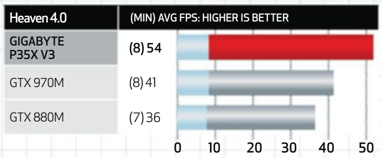
Bonkers screen, crazy performance, insanely loud. We just worry if life expectancy is as good as you'd hope…

★★★★½

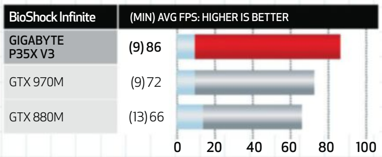
Technical analysis

Let's get one thing clear: the new GTX 980M rends all other notebook graphics asunder. There is no competition. But what's really impressive is just how close it comes to coping with the P35X's 2,880 by 1,620 native resolution. Switch off AA and it's actually gameable at max detail in many titles. Remarkable.

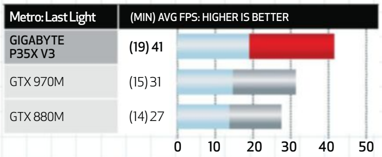
DirectX 11 synthetic performance (1,080p)



DirectX 11 gaming performance (1,080p)



DirectX 11 gaming performance (1,080p)



ARC 100 SOLID STATE DRIVE
OCZ

£86 SOLID STATE DRIVE

OCZ ARC 100 240GB

OCZ's budget SSD puts reliability to the fore, but what about performance?

VITAL STATISTICS

Price £86
Manufacturer OCZ
Web ocz.com
Capacity 240GB
Controller OCZ Barefoot 3 M10
Memory Toshiba 64Gbit 19nm MLC
Interface SATA 6Gbps
Warranty 3 years

There are few parts of the industry at the moment so volatile as the SSD world. Most other PC components are mature enough that the smaller players have faded away to leave only a few of the biggest still operating. The SSD market, though, is young enough that there are still a large number of hopefuls. We are seeing the likes of Crucial and Samsung start to pull away from the rest, though.

Until very recently OCZ was purely among the following crowd, but thanks to Toshiba splashing the cash, taking OCZ under its wing, it suddenly has a much brighter future. The reason both Crucial and Samsung have been able to build up such a lead is because they have direct access to the pricey part of the SSD package – the actual NAND flash making up the storage. Crucial's parent company, Micron, is one of the biggest producers of NAND around and Samsung also have a fair amount to call on too…

Totally hammered

Now that Toshiba is on OCZ's side with its own advanced NAND, the traditionally high price of OCZ drives is tumbling. Its latest ARC 100 SSDs are OCZ's bona fide budget offerings and, at an impressive £86, they're going right up against Crucial's MX100 range. More impressive than their pricing, the ARC 100s also have some serious performance to back them up.

Compared with a similarly sized Crucial MX100 the ARC 100 has the measure of it; not necessarily in the read speeds, but it smashes the 256GB MX100 in the write performance. That's mostly down to the density of NAND and the subsequent parallel performance it leads to. The MX100 uses 128Gbit modules, which is fine on the top 512GB version as it fills out the memory channels on the controller. On the lower capacity drives, though, there are fewer memory chips compared to the number of 64Gbit modules used in the ARC 100. That means these OCZ drives end up with better parallel storage performance.

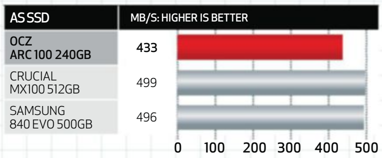
The issue OCZ drives have had in the past is their consistency and reliability. That's blighted OCZ's position in the market to a greater degree than price or the performance of its drives. The good news is the performance consistency of even this budget drive is second only to the SanDisk Extreme Pro, which is around twice the price. Using PCMark's command line storage consistency test, hammering the drive with data and speed tests over a 24hr period, the ARC 100 performs significantly better than the Samsung 840 Pro and is way ahead of the Crucial MX100. Those are both the higher-performing half-terabyte versions too.

This £86 drive is so robust that we can forgive the fact it's not on top in the straight performance metrics. The difference between those sequential speeds wouldn't be noticeable during standard usage, but if you're using data-intensive applications the differences would be. Price is such a key factor in SSDs these days that for OCZ to be on that level is important, but its consistent performance even more so. ■ **Dave James**

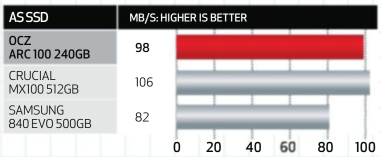
Technical analysis

In straight speed terms the ARC 100 isn't the quickest, but as one of the cheapest that hardly matters. What does matter though is the consistent performance of this drive, even when it's being seriously hammered by data.

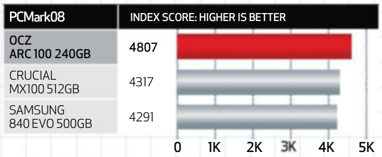
Sequential read performance



4K random write performance



Storage consistency



PCFormat Verdict

Features	★★★★☆
Performance	★★★★☆
Value	★★★★★

A great value, reliable SSD, putting OCZ back in the game and dispelling its old reputation for variable reliability.

★★★★½

£600 GAMING PC

SYBER VAPOR I

The Steam-branded Steam Machine is here! Without SteamOS, obviously…

VITAL STATISTICS

Price £599
Manufacturer Syber
Web www.sybergaming.co.uk
CPU Intel Core i3-4160 @ 3.6GHz
Motherboard ASRock H81M-ITX
Memory 8GB Kingston DDR3 @ 1,600MHz
Graphics MSI GTX 750 Ti
Storage Western Digital 1TB HDD
PSU 250W

Look everyone, our first Steam Machine has arrived! If you plugged it into your telly, started it up and left the room to make a long-brewed cup of tea, you might return thinking you had a bona fide Steam Machine in your life.

But no, the Syber Vapor I is simply the tale of another manufacturer encouraged to spend R&D money on creating a commercially viable Steam Machine and then left to twist in the wind as SteamOS enters Valve-time.

The Vapor I is set up to boot directly into Steam's Big Picture Mode as soon as Windows loads and comes with a wireless controller and micro-keyboard remote, so it can operate as much like a living room console as possible. Syber, a subsidiary of CyberPower, has done its best to make the Vapor I incredibly close to the original promise of the Steam Machine, only under the Windows ecosystem.

Because it *is* Windows, it's not a seamless process. The lethargic hard drive takes its sweet time getting into the Windows desktop and another thirty seconds or so starting, verifying and updating Steam. Because it's purely an overlay to the standard Steam client, you'll still be pulled out to navigate Windows dialogue menus out on the desktop. The upshot of that is you cannot use the gamepad alone to control the system; you'll need that trackpad/keyboard remote to get things done.

But because it is good ol' Windows you have open access to your entire Steam library of games, and whatever else you want to install on it too. This is the benefit of Valve's lackadaisical attitude towards its Linux OS, which is still very much in beta.

Hot and heavy

This Vapor I is the middle child of the family, with a Core i7/GTX 980 version covering the top-end and an Athlon X4/R9 270 at the bottom (called the Vapor A). With a dual-core, four-thread Core i3 CPU at its heart and a GTX 750 Ti this version is relatively low-end, but will still get you gaming at decent frame rates at the 1080p resolution of the TV it's designed to sit beneath.

But that lounge target doesn't sit too well with the Vapor I. Even this relatively low-powered spec still generates a lot of heat and noise, making it distracting for its intended location. It's up there with the noise a first-gen Xbox 360 made when it was really thrashing its ODD. It's also not exactly small.

The problem is that even to get down to this modest size, at this relatively low price, concessions have had to be made. The basic Core i3 is used over the Pentium Anniversary to offer a little extra threading prowess, but means you don't get the overclocking performance which generally helps boost gaming speeds. The GTX 750 Ti is a great budget card, but in a £600 machine we'd rather have the GTX 760 Scan's Performance GT managed to fit in its admittedly chunkier chassis.

In the end, though, the Syber suffers from an existential crisis. You could maybe forgive the cheap plastic feel of the chassis, but as a £600 gaming machine we really expect a little more. ■ **Dave James**

PCFormat Verdict

Features	★★★☆☆
Performance	★★★☆☆
Value	★★★½☆

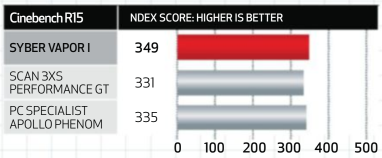
A reasonable small-form-factor PC, but £600 is a high price given the competition and what you could build yourself.

★★★☆☆

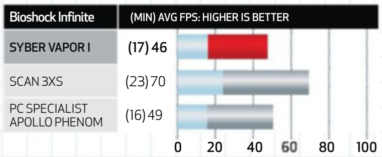
Technical analysis

The similarly priced Scan machine absolutely hoses the Vapor in terms of gaming, simply because of the mismatched graphics cards; the GTX 760 easily outpaces the GTX 750 Ti. Obviously the difference is scale – the Scan machine is a fair chunk bigger than the Vapor so it doesn't have the price premium of the small form factor.

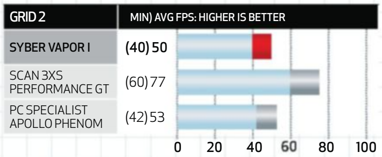
CPU rendering performance



DirectX 11 1080p gaming performance



DirectX 11 1080p gaming performance



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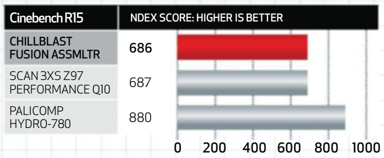
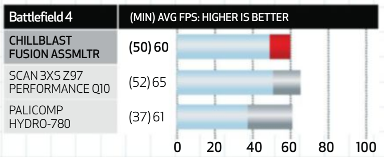
Technical analysis

Scan's competing Devil's Canyon/GTX 970 machine is rocking a higher-clocked version of Nvidia's card, but also comes at a higher price. For comparison we've also got Palicomp's £1,400 Core i7/GTX 780-based machine.

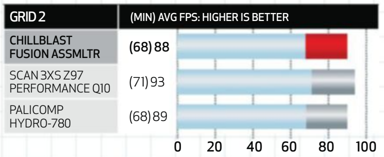
CPU rendering performance



DirectX 11 1600p gaming performance



DirectX 11 1600p gaming performance



£1,135 GAMING PC

FUSION ASSIMILATOR

So then, just how futile is resistance to Chillblast's latest mini-rig?

VITAL STATISTICS

Price £1,135
Manufacturer Chillblast
Web www.chillblast.com
CPU Intel Core i5 4690K @ 4.6GHz
Motherboard Asus Z97I-Plus
Memory 16GB Corsair DDR3
Graphics Palit GTX 970
Storage 250GB Samsung EVO SSD, 2TB HDD
PSU 750W
Warranty 5 years (2yrs collect, 3yrs labour)

The console look of the Vapor I is one way to rock the small-form-factor vibe, but Chillblast's Assimilator has chosen instead to go down the Borg Cube route. Using Corsair's mini-ITX Carbide Air 240, covered with some tasteful vinyls, the company has created a smart mini-PC that you're not going to want to hide away under a desk.

The Fusion Assimilator is unashamedly geeky, but in a quite wonderful way. Yes, this reviewer is a bit of a Trekky and that might have *something* to do with liking the vinyl detailing Chillblast has added to the Corsair chassis, but it's not horrifically garish and the Air 240 totally lends itself to the sci-fi look. We're also quite impressed with how well Chillblast has applied the decal. It does make the side-panels a bit of a squeeze when putting them back into place, but that's minor.

A good clean build

The attention to detail isn't just about the plastic wrapping around the chassis though; Chillblast has built the internals of the Assimilator with the same thought and care. The huge window in the side of the Air 240 shows off the clean build and the quality components it has used to put this machine together.

On the inside is a Devil's Canyon i5, overclocked ostensibly to 4.3GHz, but which actually turbos to 4.6GHz under load. Covering that overclock is Corsair's H100i cooler, drawing cool air in through the front vents across its 240mm radiator. Corsair is present in the hefty 16GB of DDR3 memory Chillblast has installed in the Assimilator too. There is also a decent SSD/HDD combo, with Samsung's ubiquitous 840 EVO looking after the OS in 250GB trim, with a 2TB Seagate hard drive looking after the rest of your data.

The pick of the lot though is the GTX 970 that sits at the heart of the machine. As a gaming rig, that's the component which is going to make the most difference to your overall experience. The Palit version used is a reference-clocked card, but that still gives it some impressive gaming performance – when you're talking about 60FPS at the highest 1600p settings in Battlefield 4, you know you're onto a good thing. Because it's the latest generation of Maxwell GPU it's not a particularly power-hungry or loud beast either.

That's not to say there aren't noise complaints to make about the Assimilator, however. As well-built as the machine is there was a problem with the setup of the H100i's fans, partly down to them not being connected through the motherboard to the Corsair Link software. With the mini-ITX motherboard there isn't space for the connectors to plug the USB cable into the pump, which left the twin fans on the radiator alternately spinning up and down at regular intervals. We're confident Chillblast will be able to figure out a workaround for this.

That aural issue aside, this mini gaming rig is a quite lovely little thing – even if you don't rate the vinyls. ■ **Dave James**

PCFormat Verdict

Features ★★★★☆
Performance ★★★★☆
Value ★★★★☆

A powerful, small form factor gaming rig, that should be of special interest if you're a fan of Star Trek…

★★★★☆

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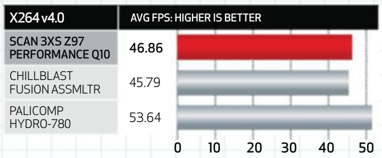
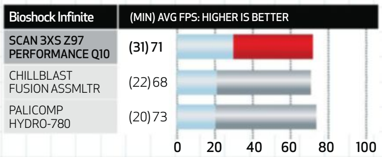
Technical analysis

The more expensive Palicomp machine with its Core i7/GTX 780 combo shows this performance isn't new, but the extra £150 over the Scan machine doesn't buy you much in-game. The Chillblast rig's less powerful GPU is also evident in the test results.

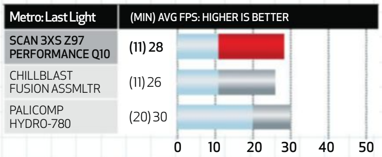
CPU video encoding performance



DirectX 11 1600p gaming performance



DirectX 11 1600p gaming performance



£1,250 GAMING PC

3XS Z97 PERFORMANCE Q10

First we had the Borg and now we've got Q. Is this a TNG reunion?

VITAL STATISTICS

Price £1,250
Manufacturer Scan
Web www.scan.co.uk
CPU Intel Core i5 4690K @ 4.6GHz
Motherboard Asus Z97-K
Memory 8GB Corsair DDR3
Graphics EVGA GTX 970 SC ACX 2.0
Storage 500GB Samsung EVO SSD
PSU 550W
Warranty 3 yrs (1yr onsite, 2yrs RTB)

We've seen Chillblast's new GTX 970-based PC and now this here 3XS machine is Scan's. When you get a pair of gaming machines built around the same new bit of kit, it's always interesting to see the different takes individual system integrators have on it. Chillblast has opted to go for a small-form-factor approach, while this Z97 Performance Q10 is classic PC tower fare.

Despite the very different chassis and the necessary choice of motherboard form factor, these two machines are very similar. They're both sporting the same Devil's Canyon Core i5, overclocked to 4.6GHz, and an Asus Z97 motherboard. Scan's 550W PSU does feel a touch miserly – not for the assembled components, but for further upgrades in the future. Instead, Scan has opted to focus more cash on the specific version of the GeForce GTX 970 it has installed into this machine. The EVGA GTX 970 SuperClocked is a highly overclocked version of Nvidia's second-tier Maxwell GPU, turbo-ing up to 1,379MHz from its 1,165MHz base clockspeed.

That gives this machine the gaming performance lead over the little Borg Cube which Chillblast has built, but does introduce its own problems. The card we had in our review version ended up being a little flaky after cooking its way through our benchmarking suite. That's not a problem with the actual build – most likely an issue with the specific card we had built into the review machine.

But this is a great place to talk about the warranty benefits of buying yourself a pre-built machine. The first year of its 3XS warranty is onsite, which means you might have a Scan man in a van at your door the following day to fix your rig if this does happen. It's not as good as it working off the bat, but it's close.

A lack of drive

Another interesting choice in the build is Scan's decision to completely eschew hard drive storage from this machine. The Chillblast rig – and most other machines we've tested since the rise of the SSD – sports a combination of smaller SSD for the operating system and a larger hard drive for general data usage.

The Z97 Performance Q10, though, plumps for a single SSD, but has used a full 500GB Samsung EVO as the base. That's not a bad choice at all, as it will take some concerted effort, a little time or a particularly excitable perusal of the latest Steam sale to fill that up. Given you can pick up hard drive storage for a pittance, that's an easy upgrade down the line and means you start off with *all* your games, application and OS running from a SSD.

The 3XS Performance Q10 may not be the most exciting-looking of machines – that Corsair 550D is an unassuming black monolithic chassis – but Scan has worked hard at making the insides as powerful as possible within the given budget. And the focus is clearly on gaming. That's why you'll find a faster version of the GTX 970 rather than the relatively unnecessary 16GB of DDR3 packed into the Assimilator. ■

Dave James

PCFormat Verdict

Features ★★★★☆
Performance ★★★★½
Value ★★★★☆

Don't let the sombre exterior fool you, this is a quality, no-nonsense gaming PC that still has a few frills under the bonnet.

★★★★☆

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Computer Shopper - 5 Stars
Expert Reviews - 5 Stars
PC Format - Gold Award
PC Gamer - 5 Stars (Editors Choice Award)

PC Format Gold

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£340 SOLID STATE DRIVE

SAMSUNG XP941 512GB

A super-fast PCIe M.2-based drive, that's tricky to track down

VITAL STATISTICS

Price £340
Manufacturer Samsung
Web www.samsung.com
Capacity 512GB
NAND Type Samsung 19nm Toggle MLC
M.2 Format 2,280
Quoted Sequential Read Speed up to 1,170MB/s
Quoted Sequential Write Speed up to 930MB/s

Ever since it became clear that the SATA 6Gbps interface had met its nemesis in the shape of the SSD, something else was drastically needed if the performance of SSDs wasn't to hit the buffers. Two contenders emerged, SATA-Express and M.2 (formally known as NGFF) – two technologies based around the PCIe lanes of the motherboard – and it looks like the latter is the way SSD technology is going.

Having said that, it seems that at the time of writing any forward movement appears to be at a snail's pace, as there are currently only a couple of true PCIe M.2 drives: the Plextor M6e (PCIe x2) and Samsung's XP941. That's the one we're looking at here, and even this is pretty hard to track down, as Samsung regards it as an OEM part.

Fast lanes

Unlike Plextor's M6e, Samsung's XP941 is a proper x4 drive, using the company's own S4LN053X01 PCIe 2.0, 3-core UAX, 8-channel controller. The XP941 is built on the M.2 2280 form factor (that is, the drive is 22mm wide and 80mm in length) with MLC NAND packages on both sides of the PCB, along with a full 512MB of LPDDR2 cache. The 512GB version of the drive uses four Samsung 64Gbit 19nm Toggle-Mode 2.0 MLC NAND chips, each NAND package containing 16 dies.

Samsung quotes sequential read/write figures for the drive as up to 1,170MB/s and 930MB/s respectively. As you can see from the ATTO and AS SSD performance scores, our test drive fell some way short of that: 830MB/s read and 714MB/s write. This had nothing to do with the drive itself, more the motherboard we were testing it on – an Asus Z97 Deluxe. The problem is that this board, like the majority of Z97 boards, only has two lanes of the PCIe bus free for the M.2 socket, which obviously impacts on the performance of x4 PCIe.

There are a few ways around this bottleneck; ASRock Z97 Extreme 6 and Extreme 9 motherboards have two M.2 slots, one driven by the chipset (PCIe x2), and the other Ultra M.2 slot which runs at 4x PCIe. Or you could get a 4x PCIe adapter to stick in a standard PCIe slot, or shell out for a X99 motherboard, which supports PCIe x4 M.2.

But even with the limitations of the motherboard used for testing, the performance potential of the XP941 is clearly seen. Looking at the headline sequential read/write speeds, it's faster than any standard 2.5in SSD we have tested to date by quite a margin, and it's a fair bit faster than Plextor's M6e drive too. There's not much to choose between the two drives when it comes to dealing with reading small, bitty files as can be seen by the AS SSD 4K read performance, but when it comes to writing, the XP941 really shows its legs – it's twice as fast as the Plextor drive for random writes. The M6e claws back a little in the real world though – the time taken to copy a 60GB Steam folder is some 42s faster.

Until consumer NVMe drives arrive (this year we're told), this is as quick as M.2 is going to get. ■

Simon Crisp

PCFormat Verdict

Features ★★★★☆
Performance ★★★★⯪
Value ★★★★☆

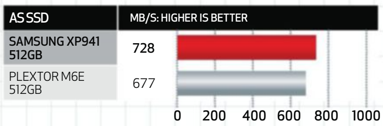
The XP941 ably shows the benefits of PCIe storage – even limited to x2 connections, it's still the fastest around.

★★★★⯪

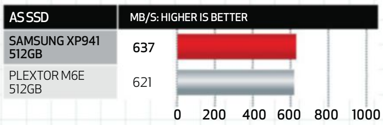
Technical analysis

The one problem we did come across before beginning testing was a small matter of the drive not booting. With some jiggery-pokery in the motherboard BIOS, this was soon fixed. As more M.2 drives appear this problem should sort itself out, but in the meantime you need to choose your motherboard carefully.

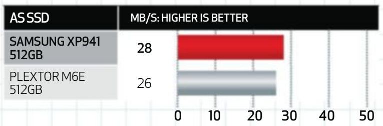
Sequential read performance



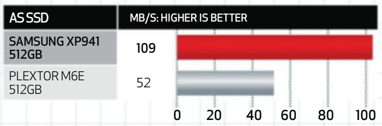
Sequential write performance



4K random read performance



4K random write performance



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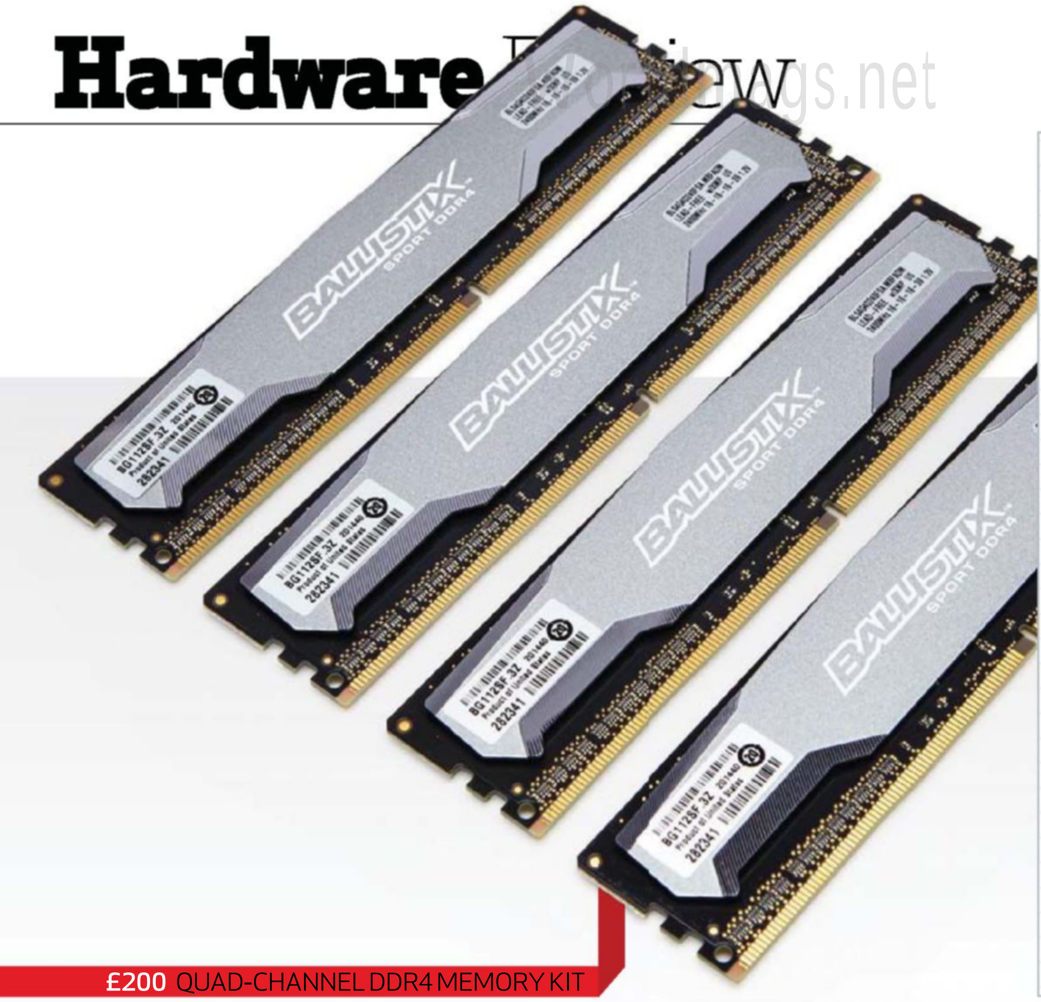
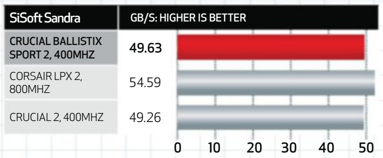


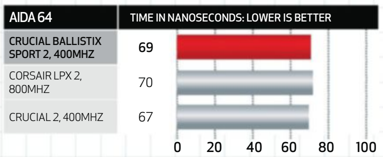
Technical analysis

We'd love to be able to tell you about the profound insight provided by our industry-leading benchmarks. Normally we can. In this case, it's all a bit of a wash. We can confirm that the Ballistix Sport doesn't overclock much better than a cheap Crucial kit and that it can't compete with seriously pricy memory when it comes to latencies. So, uh, there.

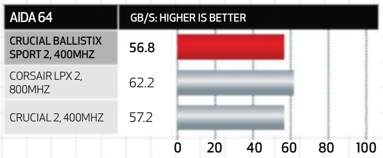
Memory bandwidth performance



Memory latency performance



Memory copy performance



£200 QUAD-CHANNEL DDR4 MEMORY KIT

BALLISTIX SPORT DDR4 16GB

A pizza with all the lashings and a handful of beers, or some premium DDR4?

VITAL STATISTICS

Price £200
Manufacturer Crucial
Web www.crucial.com
Type DDR4
CPU compatibility Intel Core i7 'Haswell-E'
Configuration 4x 4GB
Frequency 2,400MHz
Latency 16-16-16-39
Voltage 1.2v
XMP support 2.0

High-performance memory is by far and away and without a shadow of a doubt the most pointless PC component money can buy.

Hyperbolic but basically true? It's certainly the sentiment than any premium memory kit has to battle these days. The reason performance memory has become less relevant, of course, has been the demise of bus-based overclocking. With Intel's CPUs you either can't overclock, or it's done via the CPU multiplier, leaving the memory subsystem untouched. Making matters worse, what we're dealing with here is a quad-channel kit for Intel's latest Haswell-E chips on the newly revised LGA2011 socket – and that's a platform with epic memory bandwidth overkill on the desktop to start with. It's really designed for multi-CPU arrangements but in single-socket desktop trim. With four channels, it's an excess of bandwidth, it really is.

Better than boggo

The idea that you're going to see significant benefits from increased memory bandwidth, then, seems highly fanciful. What's more, the most appealing thing about Intel's new Haswell-E chips is just how affordable the entry-level six-core CPU looks next to Intel's top quad-core for the LGA1150 platform. We're talking roughly £40 for 50 per cent more cores. Fantastic.

Unless, that is, you're ramping up the overall system cost with silly-money memory. If that's the context, is there any hope whatsoever for the Crucial Ballistix Sport 2400 DDR4 16GB? Actually, a little.

That's because the price Crucial wants for this kit is also only a little extra. It's yours for £200 versus around £170 for a completely boggo 4x 4GB Crucial DDR4 kit – so if there's almost any benefit on offer, it might just be worth it. Indeed, if internal cosmetics count for you, then the £30 quid buys you some nice looking sticks with heat spreaders, not cheapo items with those white stickers. Meanwhile, the headline specs include triple-16 CAS latencies and an XMP profile setting of 2,400MHz (default for the new LGA2011 platform is 2,133MHz).

On the subject of latencies, running at the XMP 2,400MHz setting you get 16-16-16-39. That's slightly slower than the 15-15-15-36 latencies Crucial's boggo achieves running at 2,133MHz. Knock the Ballistix Sport down to 2,133MHz and the result is 15-15-15-35 – all pretty unspectacular compared to 9-11-10-30 numbers Corsair's Dominator DDR4 can achieve. That said, the Ballistix kit manages it all, including a maximum overclock of 2,600MHz at just 1.2v, which bodes well for longevity of both this kit and your system generally.

As for the benchmarks, well, check out the numbers for yourself. With the best will in the world, there's not a huge amount in it. And it's notable that it doesn't add anything in terms of maximum frequencies when overclocking compared to Crucial's basic set. All of which means the Ballistix Sport's saving grace remains that modest price premium. ■ **Jeremy Laird**

PCFormat Verdict

Features ★★★½☆
Performance ★★★½☆
Value ★★★★☆

Decent value for a premium DDR4 kit. But we might still spend the extra dosh on a night out instead.

★★★½☆

£999 EXTERNAL THUNDERBOLT 2 DRIVE

LACIE LITTLE BIG DISK

Blisteringly fast external drive with an eye-watering price

VITAL STATISTICS

Price £999
Manufacturer LaCie
Web www.lacie.com
Format External hard drive
Capacity 1TB
(2 x 512 PCIE Gen 2 SSDs)
Quoted Sequential Read Speed
1,375MB/s
Quoted Sequential Write Speed
1,180MB/s
RAID Formats RAID 0/1/JBOD
(Pre-configured RAID 0)

Mention the Thunderbolt interface to anyone and their first remark will probably be: "Isn't that just for Macs?" And while it's true that fruit-logo'd products have had Thunderbolt interfaces for some time, the interface also works with Windows-based platforms, as can be seen by the number – albeit small – of Windows notebooks that support Thunderbolt.

The latest Thunderbolt 2 (it's sooo tempting to type Thunderbird 2…) specification takes the original two 10Gbps bi-directional channels and combines them into a single bi-directional 20Gbps channel. But although the throughput of a single channel has been doubled, the actual bandwidth of data going through the connection remains unchanged. That does now mean, however, that it's possible to display 4K video using Thunderbolt.

One of the latest to join LaCie's clan of drives is the flagship Little Big Disk Thunderbolt 2, which has a quite a marketing tag to live up to: 'The World's Fastest Portable Storage.' A quick look at the performance figures LaCie quotes for the drive shows that for once it might not be marketing flimflam. Not only is it 'The World's Fastest Portable Storage', but that price must be in for some sort of prize as well.

So what's going on inside the Little Big Disk Thunderbolt 2? What enables it to produce eye-wateringly quick read/write speeds, or even begin to try to justify that price? Well, inside the wee, smart-looking aluminium enclosure (40 x 140 x 85mm) lurks a pair of Samsung 512GB XP941 PCIe x4 Gen 2 SSDs controlled by an Intel L5520 controller, set up as standard in a RAID 0 (Striped) array – although RAID 1 and JBOD arrays are supported as well.

Not only does the case act as a heat sink, there's also active cooling in the shape of a 40mm Sunon Super Silence fan – which lives up to its name, as we never heard it once even when really pushing the drive during testing.

What of buck-bang?

Plugging in the drive saw sequential read/write scores in ATTO of 1,296MB/s and 975MB/s – both of which are down on the official figures, but are still unbelievably fast for an external drive. To give an idea of just how fast the drive is we took a previous 'World's Fastest External Storage' champion from a few years ago: Western Digital's My Book VelociRaptor Duo. That drive teams up a pair of the fastest desktop 3.5in drives, WD's 10,000rpm Velociraptor, with the original Thunderbolt interface; we tested it in a RAID 0 array with ATTO, which gave Read/Write scores of 402MB/s and 365MB/s respectively.

But what about real life? We took our normal 60GB Steam folder and copied it to and from the drive. Comparing the Little Big Disk Thunderbolt 2 to the WD My Book VelociRaptor Duo showed hardly any difference between the two drives. That still makes it 'The World's Fastest', but doesn't justify that frankly insane price. ■ **Simon Crisp**

PCFormat Verdict

Features	★★★★☆
Performance	★★★★½
Value	★★★☆☆

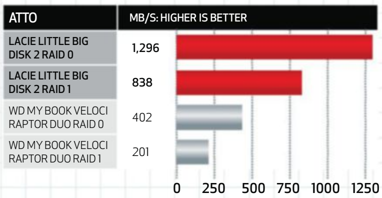
Mighty expensive, but if you are looking for a pocket-sized external drive with lightning speed then it's the only game in town.

★★★★☆

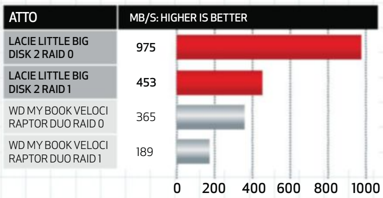
Technical analysis

Using the drive in a laptop is as easy as plugging it in, but using it the way we did – with a plug-in card, a motherboard and Windows – is a bit more complicated. It needed a BIOS update and a few tweaks in the BIOS to get the drive running.

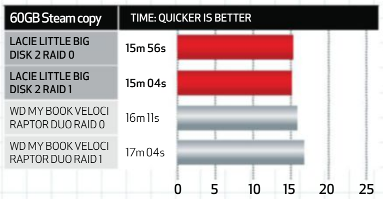
Peak sequential read performance



Peak sequential write performance



Real-world write performance



£70 GAMING MOUSE

ASUS RoG GLADIUS

We came. We saw. We conquered. We unplugged the cable and put it in a bag.

VITAL STATISTICS

Price £70
Manufacturer Asus Republic of Gamers
Web htpp://rog.asus.com
Interface: USB
Sensor: Optical
Sensitivity: 6,400dpi
Report rate: 1,000hz
OS: Windows 7 or 8

Absurdity piles upon absurdity with the titling of PC peripherals. Named after the Roman legions' short, brutal stabbing weapon, the box for Asus' Republic of Gamers Gladius mouse attempts a convoluted justification for this involving Roman generals and a motherboard named Maximus, which sounds like the worst BBC3 sitcom ever.

The Gladius is an ergonomic mouse for the right-handed community, a fairly lightweight unit with an external resemblance to the Razer DeathAdder. It comes with five programmable buttons, a wheel, two removable USB cables, some spare feet, a drawstring bag to keep it warm at night and has sides with a grippy rubber coating – which was, unfortunately, starting to peel off from our review sample.

The Gladius appeals to our tinkering tendencies by also including one spare (not two, as the packaging claimed) Omron mouse switch in the box. Replacing the switches, which are rated for 20 million clicks (so, one game of *StarCraft 2*), is a case of removing the mouse's rubber feet, undoing some screws and lifting the whole top plate off.

Rock those thumbs

Underneath the mouse there's an optical sensor rather than a laser, which means it uses an LED to illuminate the surface it's being used on. The Gladius claims sensitivity figures of 6,400dpi and a 1,000hz polling rate – identical numbers to the DeathAdder, which should keep gamers content and leave normal people reaching to turn down the sensitivity.

In the hand, the mouse feels good. It's certainly light, and what weight it has is concentrated towards the back. The shiny rubber feet underneath allow it a smooth glide across a tabletop, and the release switch for the Micro USB cable is recessed enough to prevent snagging, but not so much that you couldn't get in there in the event of a cable-swapping emergency.

The buttons are separate from the top casing of the mouse, so there's no flex as you press them. The two main ones feel as if they're made from plastic so thin it may become brittle, but there was no problem as we put them through their paces.

The side switches under the thumb were going to come in for some criticism until their true nature became apparent. They're designed to be pressed with a rocking movement of the thumb, something that should help prevent the rear button, which we found to be slightly too far toward the back of the mouse, being overlooked. The wheel has a nicely tactile stepping action, and its grippy rubber tyre means it's unlikely to slip.

Programming and profile duties are handled by the *Armoury* software, and the mouse has a little flash memory for portable profile placement. The software itself is well presented, and offers the usual options for button programming, macros, lighting control and calibration.

The Gladius is an excellent mouse for the monodextrous. It feels good, encourages a sensible hand position, and has enough buttons and options to keep just about any reasonable gamer happy. ■ **Ian Evenden**

PCFormat Verdict

Features	★★★★☆
Performance	★★★★☆
Value	★★★★☆

A really good mouse. The Gladius is comfortable, well thought-out and perfect for long gaming sessions.

★★★★☆

£40 GAMING MOUSE

GIGABYTE RAPTOR

A mouse that can rampage through a kitchen and work in packs? Clever girl

VITAL STATISTICS

Price £40
Manufacturer Gigabyte
Web www.gigabyte.com
Interface: USB
Sensor: Optical
Sensitivity: 50-4,000DPI
Report rate: 1,000hz
OS: Windows XP/Vista/7/8

The velociraptor is a creature more sinned against than sinning in terms of its modern depictions. Barely higher than a human knee, it's their portrayal in *Jurassic Park* that has sealed their reputation as efficient killers able to accurately… oh… maybe that's what Gigabyte is getting at here?

Anyway, the manufacturer has helpfully provided a diagram of the fearsome raptor foot anatomy on the box to demonstrate just exactly how unlike a dromaeosaurid claw a computer mouse is.

The Raptor is built with FPS games in mind, a specialised key reducing the sensitivity to increase accuracy in situations where small movements could lose you the shot, such as sniping. All the buttons are programmable through Gigabyte's straightforward *Ghost* software, and sensitivity adjustments can be made on the fly with two buttons above the wheel. *Ghost* also allows you to alter the number of lines scrolled with one notch of the wheel, clear the memory of saved profiles and record and edit macros to assign to a button.

The maximum sensitivity of the Raptor is 'only' 4,000dpi, bringing it in below many of its competitors, but it will still have many users selecting a lower setting as their pointer whizzes across the screen with barely an inch's movement of the mouse. LEDs tell you which sensitivity setting is active.

The position of the wheel, recessed into a cleft in the front of the unit, brings to mind He-Man's bizarre Road Ripper, a toy that baffled children who received it for Christmas in the mid-'80s. It's a fairly free-spinning wheel, raised quite high above the buttons either side but none the worse for it.

Gaming claw

The wheel position makes a lot of sense when you consider the contortions required to use it. The Raptor is a small mouse. Its design calls for the use of a claw-like grip (see what they did there?) that might be good for gaming but is about as far from the killjoy-approved Health 'n' Safety flat hand position as it's possible to get.

This is a shame, as the rubber backing of the mouse feels rather good against the palm if you do lay your hand flat upon it. Do this, however, and your fingers become too long to rest comfortably on the buttons, your thumb missing the side switches completely. It's also a light mouse, but in the box are tiny weights that slot into holes under a flap in the underside to adjust both mass and balance to your liking.

The result of a design competition run by Gigabyte, the Raptor should feel different to a lot of gaming mice, but it's more reminiscent of Apple's Magic Mouse, the touch-sensitive sliver of aluminium and plastic that doesn't have a wheel or buttons but does have a very low profile and requires strong fingertip dexterity.

Contort your hand into the perfect position and the Raptor does a reasonable job. Become frustrated with the size and lack of buttons on the right though, and those sniper headshots could pass you by after all. ■ **Ian Evenden**

PCFormat Verdict

Features	★★★★☆
Performance	★★☆☆☆
Value	★★☆☆☆

It's well-featured, but a mouse that can be a literal pain to use. For the small-handed (and right-handed) only.

★★☆☆☆

£80 GAMING HEADSET

ASUS STRIX PRO

Orange is the new black

VITAL STATISTICS

Price £80
Manufacturer Asus
Web www.asus.com
Frequency response range 20Hz-20KHz
Weight 320g
Connection type USB, 3.5mm audio jack
Driver size 60mm
Cable length 2.7m

This is one of the biggest headsets we've ever come across. *Just look at it.* You're not going to go unnoticed in a crowd with those bright orange 60mm driver units on display, not least because the sheer area they take up will give you the appearance of an unfortunate soul in the latter stages of Borg assimilation.

You have to admire Asus for going out on a limb with the STRIX Pro's design, with its clear Perspex, sharp angles, orange detailing and outright size. We think it comes *close* to good-looking, perhaps resembling an Angry Bird too much to garner fawning praise for its look. But let's not dwell on the subjectives. The really interesting number on the spec sheet is its 60mm driver size – that's *enormous* for headphones. We've been impressed by the raft of meaty 50mm-based headset units from SteelSeries et al lately, so what effect does the STRIX Pro's even larger unit have? Surely it's ten better, right?

None more orange

In practice, it's obviously not that clear-cut. Yes, there's a lot of low-end available from these phones, and it doesn't distort at high volumes. Out of the box, with no EQ-tweaking, that low-end helps shape a sound that's acceptable for music, movies and games.

If you're looking for a more precise tone, though – more clarity from your games, a more natural bass response from music – it's hard to tighten up all the loose, reverberating bass. We reckon that's partly down to the enormous earcup design, which doesn't quite 'seal' off your ear like the best cans do. They basically work like great big echo chambers around your lugs, though it must be said they're surprisingly comfortable given all those severe angles. They're lighter than they look too, at 320g. With some software EQ tuning it's possible to get the kind of sound quality you're looking for from an £80 headset, but it does take a while to find.

That's the gripes over. Elsewhere, Asus really steps up to the plate, building the headset's frame with reassuringly luxurious materials that don't creak. We're usually hesitant to use sets with floating headbands, but found this one very wearable and well-fitting.

There's great satisfaction to be had from twiddling the chunky volume dial too, which has a sticky backplate and can be fixed to your desk. Note that it does require both a USB connection *and* the usual 3.5mm audio and mic jacks, so it's not the cleanest setup.

Special mention must go to the mic's built-in noise-cancelling. Once your mic's in position, it's great at focusing in on your voice alone and filtering out the bag of McCoys you're rustling.

It's a package to recommend despite relatively lofty pricing, with a couple of minor provisos: if you fancy yourself as a bit of an audiophile, the 60mm drivers aren't a shortcut to great sound, and you will need to get your hands dirty with some EQ tweaking. Also, you'll really have to love the look – after all, it's bound to be quite a divisive one in public. ■ **Phil Iwaniuk**

PCFormat Verdict

Features	★★★★☆
Performance	★★★★☆
Value	★★★½☆

Eye-popping looks and gargantuan drivers, but it's the comfort, mic and build quality that make the STRIX Pro worth considering.

★★★★☆

£40 GAMING HEADSET

CREATIVE SB INFERNO

Creative's lukewarm budget cans are all about compromise

VITAL STATISTICS

Price £40
Manufacturer Creative
Web www.creative.com
Driver size 40mm
Frequency response range 20Hz-20KHz
Connection type 3.5mm audio jack
Mic noise-cancelling condenser
Cable length 1.2m

For £40, you don't expect to have your earlobes massaged into a state of rapture by an eSports soigneur while the last living castrato sings you lullabies about how great you are at noobstomping. It's a question of compromise – you know you're not getting the absolute best package at this price, so which attributes are you prepared to slum it with or do without, and which do you value above all else?

This humble correspondent wagers none among you mentally cast comfort into the wayside while reading that. Who cares what the bass response is like if you can't bear to wear the bloody things? Well, the situation isn't quite that dire for Creative's Sound Blaster Inferno headset, but regrettably it's comfort that feels most lacking from this offering.

Both earcups are finished with the kind of faux-velvet often found in the price range, and are generously cushioned. But the give of that cushioning – which is on the mid-point of the headband, too – is minimal, which means despite the Inferno's overall lightweight design it really feels like it's digging in almost instantly after putting it on.

Small cups

Each earcup is also puzzlingly small, so many who put the headset on will find themselves unable to make use of the closed cup design and actually fit each cup over their whole ear. If you don't have a closed cup, you get external audio leaking in, and your game audio leaking out.

Considering it makes such a poor first impression, the Inferno actually has a lot to offer elsewhere. Sound quality is clear and fairly punchy thanks to a pair of decently sized 40mm drivers, and despite the closed-cup problems there's no seashell effect from outside noise. Pump up the volume past comfortable listening territory and you'll hear the Inferno's limitations seep through in the muddy low end; however, keep the levels cochlear-friendly and you'll have little to grumble about from its sound.

The headband may be made of plain ol' plastic, but it's adjustable across just about every axis you'd care to extend or contract and doesn't produce undue creaking or cracking when doing so. Even the mic's alright, allowing plenty of adjustment and doing its noise-cancelling without too much pop and cut-out – this writer's *DayZ* collective reported nothing more than a slightly more muffled sound than usual.

The inline remote offers the basics (volume, mic mute) and does so with little fuss, and the connection's a good old-fashioned 3.5mm twin audio jack, so you can plug it into a sound card if you like. Or, pull out the twin-jack splitter and plug the single 3.5mm jack directly into your DualShock 4 on the PS4.

It has qualities then, factoring in bargain-bin pricing – but sadly the Inferno's such an awkward headset to actually wear. "Hmmph," you'll say to yourself before every gaming session, "I suppose I'll have to wear *those* again." Look into the eyes of the eSports gamers promoting the Inferno on the box and the web: they *know*. ■ **Phil Iwaniuk**

PCFormat Verdict

Features	★★★⯪☆
Performance	★★★☆☆
Value	★★★★☆

Comes close to delivering a genuinely commendable budget package, but it drops the ball on the most crucial: comfort.

★★★⯪☆

GeForce GTX 970

Without a reference design it's up to the partners to make the GTX 970 special, so who's got the best card around?

MSI

GTX 970 Gaming 4G

£268 **http://**uk.msi.com

This striking little GTX 970 from MSI is the cheapest version of the card we've found in genuine overclocked trim. But don't let that fool you – this is still a quality version of Nvidia's GM204-based card.

It does feel quite small compared with the big boys from the other graphics card manufacturers – there are only a pair of, admittedly rather chunky, fans on top of the heatsink. But this latest version of MSI's GPU cooling, the Twin Frozr V, is more than capable of keeping the powerful GPU in check. It's not quite as chilled out at standard levels as either the Zotac or Gigabyte coolers, but it's got the STRIX licked.

The stated turbo of 1,279MHz we actually found quite conservative in our testing – and not just because of the winter weather. (We don't feel it – Dexter has the heating on full-blast here in *PCF* Towers to try and drum up support for Naked Wednesdays). Despite that, the Gaming 4G sat at a minimum of 1,303MHz when in-game, which meant it posts very competitive gaming benchmarks. Combined with the 0dB Twin Frozr V cooling it to below 62°C, the MSI card is a tasty choice for a well-priced GTX 970. ■

VITAL STATISTICS

GPU turbo 1,279MHz
Max temperature 63°C
Peak power 294W

★★★★☆

Gigabyte

GTX 970 G1 Gaming

£288 www.gigabyte.com

Gigabyte's heftily overclocked G1 Gaming was our first taste of Nvidia's second-tier Maxwell and it's still probably our favourite on the balance of play. It's a beefy card with three spinny fans in its WindForce cooling array, which at once keeps it cooler than any of the other cards here and allows it to top 1,500MHz and still stay below 65°C.

They're pretty quiet too, though the WindForce isn't running the same sort of 0dB fans as the MSI or Asus cards. That's the only slight downside with Gigabyte's WindForce tech, but given that it's the most chilling setup of all the GTX 970s we've seen we can forgive the triple-fan whisper – especially since it's liable to be drowned out by the rest of the fans in your machine.

When it comes to performance the G1 Gaming is generally the fastest in our various GPU testing benchmarks. There are some times where the Zotac card can post higher numbers, but overall the Gigabyte card still holds sway.

The only real issue with the G1 Gaming is that it's such a relatively power-hungry card. It posts the highest peak platform numbers, which inevitably stretch even higher when you're overclocking it. But it's still a great price for an overclocked GTX 970. ■

VITAL STATISTICS

GPU turbo 1,329MHz
Max temperature 58°C
Peak power 310W

★★★★½

Asus GTX 970 STRIX OC Edition

£294 www.asus.com

We're actually a little disappointed with Asus' STRIX OC Edition; given that the Strix of ancient Greece myth was a bird of ill fortune, that maybe shouldn't be such a surprise. Despite the high price of the STRIX OC Edition there is nothing about it to separate it from the other, cheaper cards we've tested this month. It's by no means the fastest or the coolest, nor is it the most capable overclocking card.

The more modern, owly reference to STRIX, though, is quite fitting owing to that pair of wide-eyed fans set into its angular plastic surround. The cooling array is still pretty impressive – it is the warmest of all the chip-chillers here, but when we're still talking as cool as 67°C under load that's not at all bad.

It's also another of the 0dB crowd, meaning the fans only actually kick in once the GPU gets up above 66°C. For the record, that max temperature remains the same even when you push the clocks up to their 1,493MHz overclocked peak.

But it is those clocks which represent the problem here. Despite being one of the priciest cards it's got the absolute lowest baseclock of the lot, unable to generally get up past 1,278MHz under load. ■

VITAL STATISTICS

GPU turbo 1,253MHz
Max temperature 67°C
Peak power 277W

★★★½☆

Zotac GTX 970 AMP! Extreme

£330 www.zotac.com

This latest Zotac card really looks like it's straight out of the '90s. The brash, angular design of its massive build is matched only by the garish green/red lighting that runs its length. It's not quite triple-slot, but the large cooler's width means you'll need to get the ruler out to check it will definitely fit in your chassis. It's also rather high off the motherboard too. Seriously, this thing is big.

But that pays off when you start to mess around with the clockspeeds – though with the standard turbo actually running with a 1,379MHz minimum you could easily argue you don't need to get tweaking. However, you would be missing out on why this card costs more than any of the other we've tested.

This is *the* overclocker's card of this set. We reached the highest stable clockspeed we've hit with a GM204 GPU. At 1,546MHz that's a fair bit further than we managed with even the Gigabyte card, and the Asus and MSI cards couldn't top 1,500MHz without serious visual artefacting. The USB-based overclocking also enables you to hit automatically tuned clockspeeds without invalidating your warranty – up to an impressive 1,461MHz. The problem is it's far more expensive than the rest; if you're desperate for the absolute fastest possible GTX 970 it's a winner, though. ■

VITAL STATISTICS

GPU turbo 1,355MHz
Max temperature 63°C
Peak power 283W

★★★★½

RIG BUILDER

Whether you're upgrading your PC or starting anew, this is the best kit

One of the joys of owning a PC is that you can upgrade it as you go. Need higher frame rates in games? Drop in a newer graphics card. Want more power elsewhere? Grab a new processor or go for that old favourite: a memory boost. There's a wealth of upgrades that can transform your machine, and you can change slowly over time to suit your budget, so you rarely have to suffer a sluggish rig for long. Every now and then, the best possible upgrade is to dump your current rig and start afresh by building a whole new machine from scratch.

What sort of machine should you build, though? Which items are important? Which work well together? How much should you be budgeting for? That's a lot of questions, and getting the right answers means having to go and research all the current trends in order to make the best decision. Before you do that, though, take a look at our guide. You'll discover that we've taken the hard work out of the equation and presented you with three machines that fit three different budgets.

On these pages are our usual recommendations for putting together a budget, mainstream and stupidly powerful high-end machine. These rigs all include a screen and peripherals in the ticket price, so if you're keeping your existing goodies then you'll have more cash to spend elsewhere. What's our recommendation if you find yourself with that pleasant problem? Either get a larger SSD or a more powerful GPU. Happy building, you lovely people! ■ **Dave James**

HOW TO...
BUY A GRAPHICS CARD

If you want to play modern PC games you're going to need to have a graphics card in your machine. As much as integrated processor graphics have improved, they're a pale imitation of a dedicated pixel-pusher.

But how do you choose the right card for you? Ask yourself: what screen are you looking to drive and how much are you willing to spend? The panel you're choosing is important because that dictates the native resolution you're ideally looking to game at. If it's 1440p or above then you need to spend a pretty penny on your GPU in order for it to be able to deliver a smooth experience at that level. Conversely, if you're only rocking a 1080p screen, then you don't need to spend any more than £150-£200 to get top performance. Obviously you should only spend what you can afford, but the more cash you put into your purchase the more performance you'll get out, so don't be too stingy.

BUDGET

MOTHERBOARD	■ Gigabyte B85M-D2V	£41
CPU	■ Intel Pentium G3258	£50
MEMORY	■ Crucial 2x 2GB DDR3 1,600MHz	£33
GRAPHICS CARD	■ MSI GTX 750 Ti OC	£114
SOLID STATE DRIVE	■ Crucial MX100 256GB	£80
CPU COOLER	■ Intel Stock Cooler	NA
POWER SUPPLY	■ SilverStone Strider E 500W	£44
CHASSIS	■ Corsair Carbide 200R	£45
OPTICAL DRIVE	■ LiteOn IHAS124-14 24x DVD±RW	£12
SCREEN	■ AOC E2250SWDNK	£79
Total		£498

MAINSTREAM

MOTHERBOARD	■ Asus Z97-A	£107
CPU	■ Intel Core i5-4690K	£175
MEMORY	■ Corsair Vengeance LP 8GB	£58
GRAPHICS CARD	■ Sapphire R9 285	£179
SOLID STATE DRIVE	■ Crucial MX100 512GB	£150
CPU COOLER	■ Enermax ETS-T40	£28
POWER SUPPLY	■ OCZ ModXStream Pro	£52
CHASSIS	■ Cooler Master CM690	£76
KEYBOARD	■ Corsair Vengeance K65	£70
SCREEN	■ Viewsonic VX2263Smhl	£118
Total		£1,013

HIGH-END

MOTHERBOARD	■ Asus X99 Deluxe	£236
CPU	■ Intel Core i7-5960X	£769
MEMORY	■ Corsair Vengeance LPX 16GB	£283
GRAPHICS CARD	■ MSI R9 295X2	£700
SOLID STATE DRIVE	■ Samsung 840 EVO 1TB	£389
CPU COOLER	■ Thermaltake Water 2.0 Ext.	£105
POWER SUPPLY	■ CM Silent Pro Gold 1000W	£171
CHASSIS	■ CM Cosmos 2 Ultra	£286
KEYBOARD	■ Corsair Vengeance K70	£120
SCREEN	■ HP ZR30W 30-inch	£922
Total		£3,981

BUDGET

WHEN EVERY POUND COUNTS, SPEND THEM WISELY

MOTHERBOARD
Gigabyte B85M-D2V

This micro-ATX board is the perfect match for Intel's bargainous Pentium Anniversary CPU, with good connectivity and decent overclocking chops to boot.

CPU
Intel Pentium G3258

Poor AMD – it's a clean sweep for Intel on all our recommended rigs. The new Pentium is simply the best budget chip around, offering Haswell for peanuts.

CPU COOLER
Intel Stock Cooler

The Pentium Anniversary chip is a very cool-running CPU, even when overclocked. We managed a stable 4.2GHz on this stock Intel cooler.

MEMORY
Crucial 4GB 1600 DDR3

Memory pricing continues to be incredibly volatile, but it's still a great time to squeeze more sticks into your rig. You really should see 4GB as the minimum these days.

GRAPHICS CARD
MSI GTX 750 Ti OC

Nvidia's latest GPU is quite a feat of engineering because of that brand new Maxwell architecture. The MSI card is a bargain at this price too.

SOLID STATE DRIVE
Crucial MX100 256GB

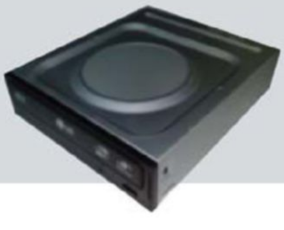
The 256GB version may lag behind the 512GB drive, but it's got enough space to be going on with and is much quicker than any HDD you can put it up against.

POWER SUPPLY
SilverStone Strider E

We may be talking about a budget rig here, but it's still a rather hefty chunk of cash to risk on a no-name power supply. This 500W SilverStone PSU will give you peace of mind and all the PCIe leads you need.

OPTICAL DRIVE
LiteOn IHAS124 DVD+RW

We really wonder whether you actually need an optical drive anymore, but for now we'll err on the side of caution and include one in the list. Don't feel bad if you forget to buy it though.



CHASSIS
Corsair Carbide 200R

Much more impressive than its price may lead you to believe, the clean lines and added extras of this chassis make it the budget case to beat. An understated bargain.

SCREEN
AOC E2250SWDNK

This 21.5-inch panel has a native resolution of 1,920 x 1,080 and looks pretty good despite that ridiculously-low price. It's no IPS-beater, but it'll do for half the cash.

MAINSTREAM

YOU DON'T HAVE TO SPEND A FORTUNE TO GET A STUNNING RIG

MOTHERBOARD
Asus Z97-A

We've seen a lot of Z97 motherboards since this Asus offering was released, but nothing newer has managed to push it off this list. Great features at a great price. Simple really.

CPU
Intel Core i5-4690K

For almost the same price as the ol' 4670K you can pick up one of the newer Devil's Canyon CPUs. It's only got a 100MHz clock boost, but the new design helps when it comes to overclocking.

CPU COOLER
Enermax ETS-T40

Enermax has simply amazed us with this, its first CPU cooler. The performance is excellent, the price is astonishing, it's easy to fit and it isn't so big that it limits your case or mobo choices.

COOLER MASTER

MEMORY
Corsair Vengeance LP 8GB

This pair of 4GB sticks will give you all the performance you could ever want, and they're in *Star Wars* stormtrooper-white. They'll only take up two slots in the board, too.

GRAPHICS CARD
Sapphire R9 285

The newer Tonga Pro GPU in AMD's R9 285 is an impressive wee thing, making it our favourite sub-£200 card right now. The 2GB frame buffer might be a worry for the high-res future, but it's a beauty.

SOLID STATE DRIVE
Crucial MX100 512GB

Crucial has made a big splash in the SSD market with this chunky drive. The 512GB version is quicker, larger and cheaper that the 480GB M550.

POWER SUPPLY
OCZ ModXStream Pro

If you want to build a performance machine, you're going to need a powerful PSU. This 500W baby will power the rig with extra to spare. It's quiet as well.

KEYBOARD
Corsair Vengeance K65

We love a good mechanical-switch keyboard here at *PC Format*, and Corsair is making some of the best. The K65 is a great compact option, with a compact price to boot.

CHASSIS
Cooler Master CM690

The CM690 eschews silly gimmicks in favour of producing a no-nonsense chassis that has plenty of cooling options for your mainstream rig. There's space aplenty inside, and all at a reasonable price.

SCREEN
Viewsonic VX2263Smhl

The old 23-inch Viewsonic IPS seems to be EoL now, but this white one has got the budget IPS panel and decent performance for its bargain £118 price tag.

HIGH END

IF YOU REALLY WANT TO TREAT YOURSELF, THIS IS HOW TO DO IT

MOTHERBOARD
Asus X99 Deluxe

As usual this Deluxe board from Asus is absolutely stuffed with funky features. It's one of the finest, and best-looking, X99 boards around and not a bad overclocker either.

CPU COOLER
Thermaltake Water 2.0 Ext.

Why settle for a reasonable overclock when you can hit 5GHz? This kit is speedy, boasts incredible performance and is quiet in operation.

MEMORY
Corsair Vengeance 16GB

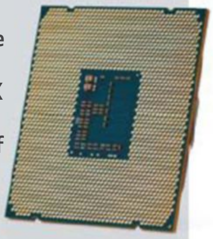
The Haswell-E platform is the first to bring DDR4 to the consumer. That does though come at a hefty price, but it's damn quick…

GRAPHICS CARD
MSI R9 295X2

The dual-GPU R9 295X2 is undeniably the quickest card around. We still worry about these sort of cards, but the liquid-chilling helps those concerns, and it's a beast at 4K.

CPU
Intel Core i7-5960X

If you're after the fastest, most advanced CPU around, then this 8-core, 16-thread Haswell-E is it. There is also the 6-core i7 5820K for a more reasonable £300, but the 5960X is the pinnacle of modern CPUs.



SOLID STATE DRIVE
Samsung 840 EVO 1TB

It's been a while coming, but we're finally seeing terabyte-class SSDs at a decent price. The 840 EVO uses some impressive algorithms to offer high speed, too.

POWER SUPPLY
CM Silent Pro Gold 1000W

Cooler Master continues to impress with its power supply units, and this wonderful box of tricks managed to scoop the gold award in our exacting test way back in PCF246.

KEYBOARD
Corsair Vengeance K70

Corsair's update to the older Vengeance keyboard rights all its older sibling's wrongs. It's also a truly stylish gaming board, with the red backlight glowing against a brushed-metal chassis.

CHASSIS
CM Cosmos 2 Ultra

Cooler Master has always been an impressive maker of cases, but it has truly stunned us with this chassis. Yes, it's expensive, but if you can afford to drop this much on your case, you'll be more than happy.

SCREEN
HP ZR30W 30-inch

HP's 30-incher is exactly what high-end gaming means to us and if money is no object, this is the screen to buy. You'll need the R9 295X2 to really show it off.

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MORE RAM THAN YOU CAN HANDLE
SAPPHIRE RADEON R9 290X 8GB RATED
LINUX IS NOT THE ANSWER!
HOW WINDOWS SAVED STEAM BOX
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ISSUE 300/JANUARY 2015
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Tech Porn

Performance kit laid bare

1 Hotspots The ol' Vapor I is a rather toasty, blowy machine despite it's relatively low-power components. The GTX 750 Ti isn't a particular power-hog, nor the Core i3 CPU, but still it puffs out a fair amount of hot air and does it quite loudly too.

SYBER VAPOR I

This wee machine might look a little familiar to some as it was part of the biggest PC hype of last year: the rise of the Steam Machine.

Valve saw something evil in the future of Microsoft's Windows operating system

2 Intel inside

The top two tiers of the Vapor machines are Intel-based, but there is a bottom-end AMD version with an Athlon X4 CPU. This middle order is decent-priced and packs a good 1080p gaming punch.

3 Lighten the load

At the press of a button you can change the lighting design of the Vapor I. Around the outside are thin strips that can display a number of colours, presumably depending on the decor of your living room…

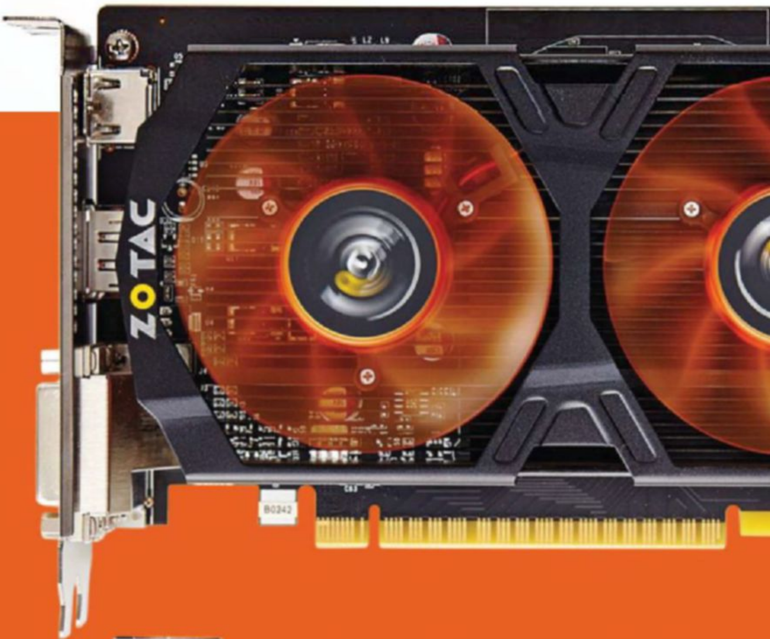
and set about trying to generate a groundswell of support for its own Linux-based operating system SteamOS. It worked with game developers, produced its own prototype game controllers and even its own prototype Steam Machine. Valve also encouraged manufacturers to create their own bespoke designs and I witnessed the unveiling high above Las Vegas last January. And then it all went quiet.

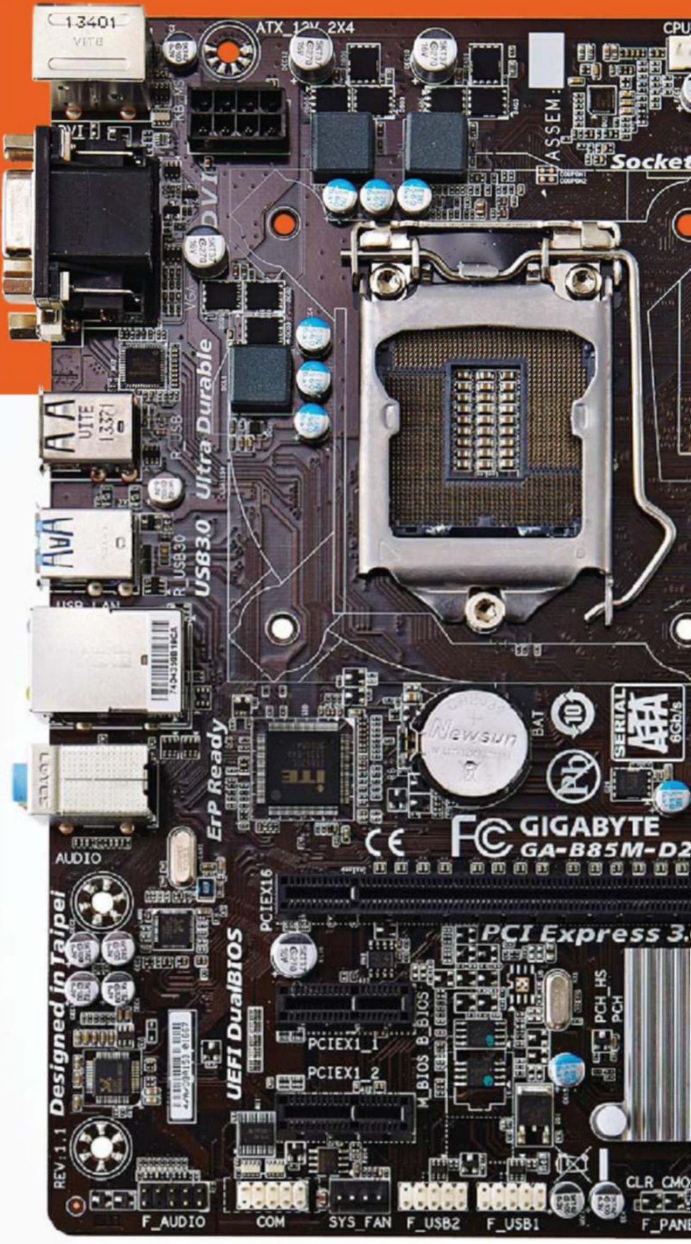
So now those same manufacturers are trying to recoup some of the R&D cost by shipping their branded Steam Machines with a Windows OS instead.

Syber has tried to make this as close as possible to the original vision – closed source OS notwithstanding – but it's still not quite the same without the SteamOS. ■ **Dave James**

THE COMPONENTS

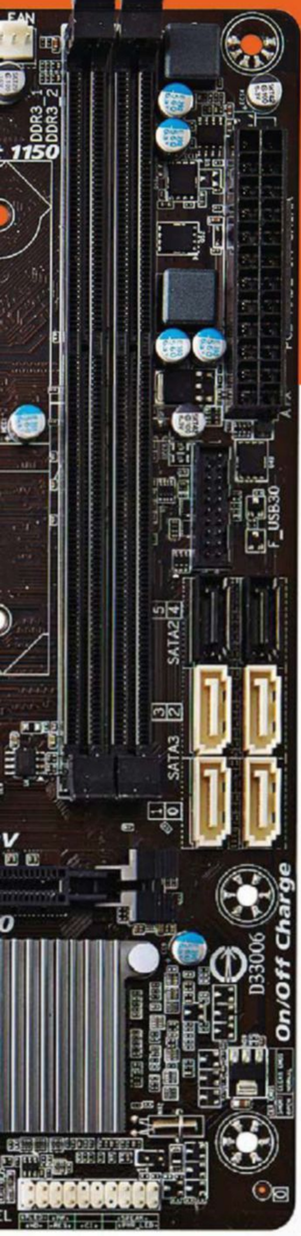
CPU	
Intel Pentium G3258	**£47.90**
Motherboard	
Gigabyte B85M-D2V	**£41.25**
Memory	
Crucial 4GB DDR4 1,333MHz	**£26.99**
Graphics card	
Zotac GTX 750 Ti	**£99.99**
Storage	
Western Digital 500GB Caviar Blue	**£35.99**
Chassis	
Gigabyte GZ-MA02 4-in-1	**£47.98**
PSU	
Gigabyte 450W 4-in-1	**N/A**
Keyboard	
Gigabyte 4-in-1	**N/A**
Mouse	
Gigabyte 4-in-1	**N/A**
Total	**£300.10**




Ultra Durable
USB3.0
ErP Ready
UEFI DualBIOS
Designed in Taipei
GIGABYTE
GA-B85M-D2
PCI Express 3.
AUDIO
F_AUDIO
COM
SYS_FAN
F_USB2
F_USB1

WD
500GB
SATA / 16MB Cache
WD5000AAKX
WD Blue
Desktop Hard Drive

BUILD A £300 GAMING PC



FORGET THE JANUARY SALES, WE DON'T NEED TO EXPERIENCE THE CRUSH TO GET OURSELVES A BARGAIN GAMING PC. HERE'S HOW TO BUILD YOUR OWN CONSOLE-BEATER

Had you told our PC Format ancestors, some 300 issues ago, that in 2015 you could build yourself a gaming rig for £300, they would have laughed in your face and gone back to playing *Secret Weapons of the Luftwaffe* on their £3,000 33MHz 486. But the world has moved on and, despite jeers to the contrary, PC gaming is a huge industry and the hardware needed to get involved is cheaper than its ever been. More importantly though, it's also more powerful.

There are some key reasons we're now able to put a gaming rig together for just £300 and it's all to do with the specific components that have been released over the last 12 months. Without the combination of Intel's Pentium Anniversary chip, the flouted overclocking limitations on Gigabyte's B85 motherboard and Nvidia's bargain-priced GTX 750 Ti, a machine built on this budget would scarcely cope with the rigours of *Minesweeper*. Those smart little components form the core of our budget hero, and they make this a great machine for dealing with the latest games at 1080p, even at the highest possible settings.

The hardware is obviously a huge part of what makes this all possible, but we do have to give a nod to the longest-lived console generation there has been in modern times. The PS3 and Xbox 360 pioneered the 1080p resolution as the de facto standard for gaming – and so it has remained in the mainstream, for almost a decade. As console hardware remained the same, though, PC components have kept advancing – today, running the latest games at 1080p is nothing out of the ordinary for a £100 discrete GPU.

This isn't just a bare bones PC either; that bargain price includes case, keyboard and mouse. Just plug the setup into your existing monitor and you'll be gaming in no time. So, how have we put this all together? Turn the page to find out.

Worldm

Chassis

Gigabyte GZ-MA02 4-in-1

✓ To be fair, without this bargain little Gigabyte package this machine would be a rather bare bones affair and nowhere near so functional. There is nothing hugely exciting about the understated, simple black mini-tower chassis, but it's got an effective front panel and space for all your budget components inside.

The real kicker is that this bundle comes with a 450W power supply, which is more than capable of coping with the parts we've chosen and provides some headroom for possible upgrades too. It also comes with a keyboard and mouse combo, which means you just need a monitor to plug it all into and you're good to go.

Socket 1150
GIGABYTE
GA-B85M-D2V
PCI Express 3.0
Ultra Durable
UEFI DualBIOS

Motherboard

Gigabyte B85M-D2V

✓ The price of this wee board is astounding, but so is its functionality. The mini-ITX form factor means that there's only space for one pair of DIMM slots and a single PCIe 3.0 x16 connection, which somewhat limits its upgrade possibilities.

For a budget build, though, you wouldn't expect to be going multi-GPU any time soon. It still has support for SATA 6Gbps and USB 3.0 connections, plus an upgrade path for your CPU up to a Haswell Core i7.

Because it's a B85 chipset, it has overclocking support too. It shouldn't, according to Intel – but the mobo manufacturers have been happily flouting overclocking restrictions for a couple of CPU generations now.

CPU

Intel Pentium G3258

✓ The dull G3258 nomenclature really doesn't do this processing hero justice – you might better know it though as the Pentium Anniversary Edition. It was launched to celebrate the 20th anniversary of the first Pentium and packs two cores of Haswell power into a bargain package.

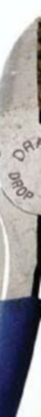
You may reasonably suggest that, without the added bonus of Intel's HyperThreading tech, this resolutely dual-core chip is too much of a nostalgic throwback to be a worthwhile gaming CPU. That might be true were it not for the Pentium Anniversary's not-so-secret weapon: overclocking. Even with the stock Intel CPU cooler we were able to get it running stably at 4.2GHz, and that speed arguably makes more difference to gaming performance than more expensive multi-threading capabilities.

Graphics card

Zotac GTX 750 Ti

✓ The first flush of Nvidia's Maxwell architecture was a sneak peek into what was to come with the more high-end GTX 980 and GTX 970 cards. The GTX 750 Ti displayed impressive performance with an incredibly low power draw and price – and still does.

This Zotac version is just £100, but can happily cope at 1080p resolutions with most modern games at decent speeds. Knock the graphics settings down a notch in-game and you will find impressively smooth frame rates. It's not quite as quiet as the more expensive, passively cooled Palit card we've looked at before now, but it runs a fair chunk cooler and just as quickly.

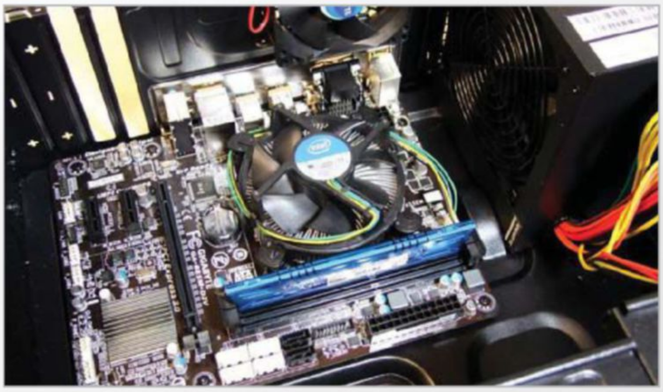


Building the PC Format Budget Hero

We've picked the parts now here's how to put them all together

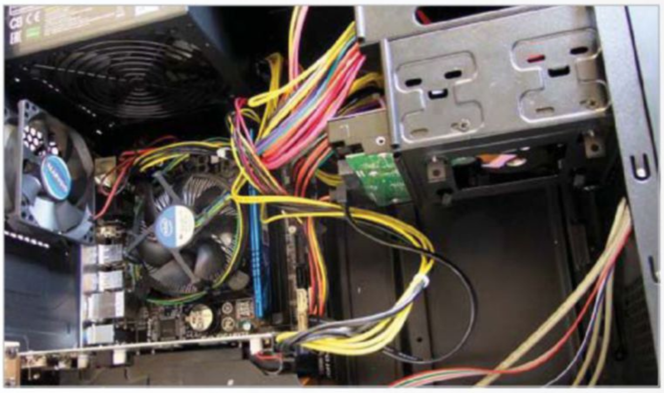
1 Check it all works

When it comes to building from scratch you're likely to have to do some troubleshooting along the way. To make things easier start by putting the main bits together outside of the case. Plug the CPU, cooler (don't forget thermal paste) and memory into the motherboard, drop in the graphics card and plumb in the PSU. Attach it to the monitor and start it up to make sure it reaches the POST.



2 Time to move in

With the main parts set up outside the case any potential problems will be easier to isolate, but it will of course all start up perfectly… Detach the cabling and GPU to make it simpler to slide into the chassis, but you can leave the memory, CPU and low-profile Intel cooler attached. Attach the motherboard's backplate to the chassis and screw the board et al into the case's mounting points.

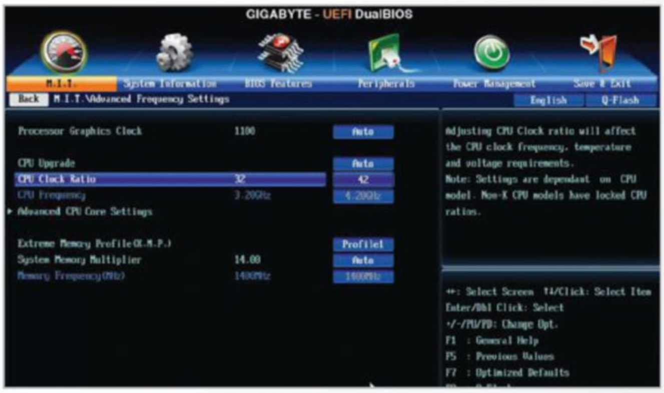


3 Plug in the juice

Once the board is securely screwed into place, it's a good time to attach the chassis' front panel connectors to the board. Use the motherboard manual to locate the right pins on the board and plug the USB and audio cables into the headers on the board. Now plug the power supply points into the ATX 12V socket and longer main power slot, drop in the GPU and make sure it's attached to the PSU.

4 Check for movement

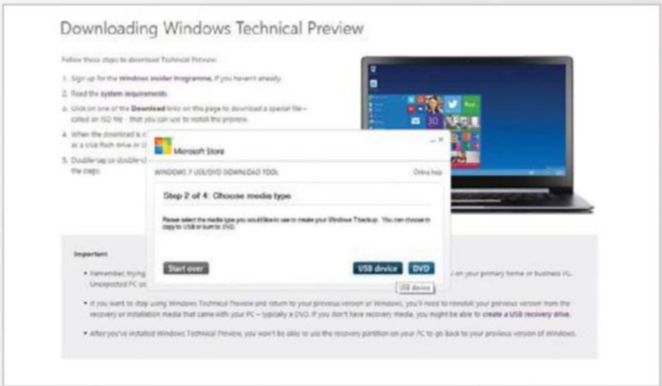
That should be everything plumbed into the chassis now. Don't slide on the side panel just yet, we want to make sure all the fans are spinning before we do that. Plug your new rig into a monitor, attach the keyboard and mouse and connect it to your network. Now, cross your fingers and hit that power switch. When the machine bursts into life make sure all the fans are spinning and close up.



```
M.I.T.\Advanced Frequency Settings

Processor Graphics Clock        1100       Auto

CPU Upgrade                                Auto
CPU Clock Ratio                 32         42
CPU Frequency                   3.20GHz    4.20GHz
▸ Advanced CPU Core Settings

Extreme Memory Profile(X.M.P.)             Profile1
System Memory Multiplier        14.00      Auto
Memory Frequency(MHz)           1400MHz    1866MHz

Adjusting CPU Clock ratio will affect
the CPU clock frequency, temperature
and voltage requirements.
Note: Settings are dependant on CPU
model. Non-K CPU models have locked CPU
ratios.

↔: Select Screen  ↑↓/Click: Select Item
Enter/Dbl Click: Select
+/-/PU/PD: Change Opt.
F1  : General Help
F5  : Previous Values
F7  : Optimized Defaults
```

5 Overclocking for starters

Once the machine reaches the POST screen it will more than likely ask to be taken to the UEFI BIOS to set up the new CPU. If not, hit DEL or F2 and take it there yourself. Quickly check the temperature of your CPU in the BIOS, all being well it should be around 30-35°C. Now you can overclock - throw the multiplier up to 42 (for 4.2GHz), hit the RAM's XMP settings and let's get you an OS.



Downloading Windows Technical Preview

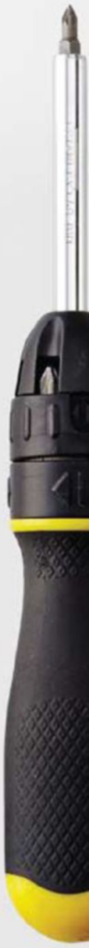
Microsoft Store

WINDOWS 7 USB/DVD DOWNLOAD TOOL

Step 2 of 4: Choose media type

6 Windows for free

Sadly you'll need another machine for this - or have already done this step previously. You need to head to http://goo.gl/a4Hd1B and download the Windows Technical Preview ISO to get a genuine free Windows OS. Install it to a 4GB USB stick using the Windows USB/DVD Download Tool (wudt.codeplex.com) and boot your freshly machine with it. In fifteen minutes you'll be up and running.



DRAPER
FORGED

Technical analysis

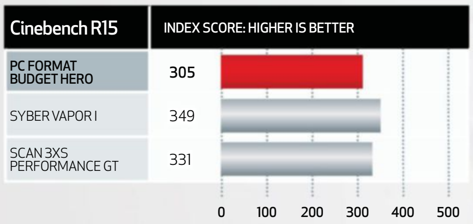
Taking on the big boys

We don't really review gaming PCs that cost £300. That's mostly because they don't exist; the sort of desktop machine you could buy for that price would be some integrated GPU-hobbled beige box which would wind up wheezing after ten seconds with *Half-Life 2*.

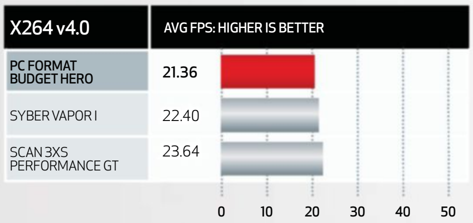
That means we don't have a lot of comparative numbers for our PC Format Budget Hero machine, but we have recently checked out a couple of rigs with similar specs. The Syber Vapor I pseudo Steam Machine we've reviewed this issue is a good example (see page 28), packing in a low-end Intel CPU and GTX 750 Ti, and so is Scan's 3XS Performance GT. That's another Pentium Anniversary rig, but with a GTX 760 doing the graphical grunt work it's got a lot more about when it comes to throwing polygons around.

The important factor here though, is the price. Both the competing machines from Syber and Scan cost exactly twice as much as the ticket price of our own £300 PC. The gaming performance is better with the Scan and its pricier GPU, but we'd argue it isn't *twice* as good.

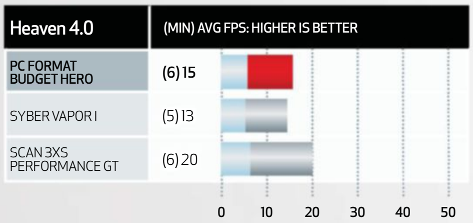
CPU rendering performance



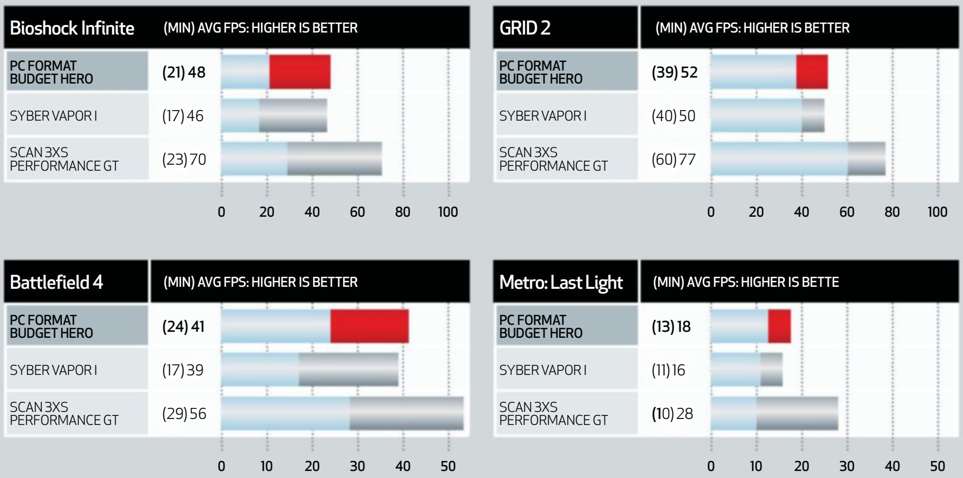
CPU encoding performance



DirectX 11 1600p synthetic performance



DirectX 11 1080p gaming performance



THE PC FORMAT BUDGET HERO

GIGABYTE
CHASSIS

The most important thing about the *PC Format* Budget Hero is that this is a platform to build from and to add to. Obviously, at this price, we're not going to be able to fit it out with the absolute latest and greatest technology on offer – we can't stretch our £300 budget to include an SSD of any worth, or a heavily multi-threaded CPU – but we've created a system without a full stop at the end. This bargain-priced rig will form the basis for a pretty substantial upgrade path in the future.

The CPU can be upgraded all the way up to an Haswell Core i7, the memory up to 16GB and the 450W PSU will cope with all but the most power-hungry of graphics card. That means you can happily run this rig with your 1080p display right now and know you can pick and choose your upgrades later on.

We're also not suggesting that this is the only way to go either. If you can stretch your budget a little you could make your own changes to this base build. Another £86 will net you an OCZ ARC 100 240GB SSD to give you some speedy storage, though that might be a better upgrade down the line if you can put up with the slower loading of a spinning-platter hard drive.

A more pertinent upgrade would probably be on the memory side. Filling that other DIMM slot with another 4GB of RAM will give you enough system memory to cope with pretty much anything you might want to do, and give you the added bandwidth of a dual-channel setup. We also found it smoothed out open-world games, such as *Far Cry 4*, when loading in new areas.

While we're on *Far Cry 4* it's worth mentioning that there are dual-core limitations for that title. We're starting to see some games with quad-core CPU minimum requirements; and while there are often workarounds for this, they will need some fiddling. The *Far Cry 4* fix is relatively simple, just requiring a little timing, and the added overclocking performance of the Pentium Anniversary makes it a perfectly adequate CPU for that game. We managed a healthy 30FPS at 1080p Ultra settings and well over 40FPS when dropping the settings down a notch.

Go for a slightly higher-spec GPU though and those frame rates will jump up. AMD's R9 285 is just £165 and can outperform the GTX 760 in the Scan machine we've compared our Budget Hero with. That's a great upgrade for this machine, or a good starting point if you're able to spend a little more on the GPU side.

The elephant in the room is the operating system. Picking up a copy of Windows 8.1 is going to add at least another £78 onto the price and, even though it will be free, the cost to your sanity of trying to run a Linux-based gaming rig will be far too high for most. When you're at this budget end of the spectrum, the cost of a Windows OS is over a quarter of your budget. But there is another way: become a guinea pig.

Until late spring 2015 you will be able to happily run a supported, free Windows operating system. We're not talking about some low-end, feature-light version either – we're actually referring to the most up-to-date OS around, Windows 10. Well, not quite Windows 10, but the Windows Technical Preview. It *is* a beta OS, but we've been running it in the office since release and it's been generally stable. This is the OS we've ran all our benchmarks on,and it's been very happy. And free too.

> "A more pertinent upgrade would probably be on the memory side"

So there you have it, the £300 *PC Format* Budget Hero. We're very proud of our little rig, especially given its incredible value, as it shows the fantastic versatility in the PC platform. Sure, you can build £3,000 gaming behemoths, but that's easy. When you've got a tenth of the budget, that's the real challenge… and one well worth indulging in. ■

Gaming &

Because gaming is a way of life

> "The Black Glove was an incredibly ambitious project, but sadly it just wasn't to be"

Break out the eggnog, it's time for a merry *PCF* Crimbo! Festively obsessed father of two **Dom Reseigh-Lincoln** is wringing his hands with glee at the thought of a fridge full of cider and ale, a life-shortening amount of roasted meat, a hearty serving of *Doctor Who* and a holiday full of rooftop clambering. Yep – it's all about slicing up French nobility in *Assassin's Creed Unity*.

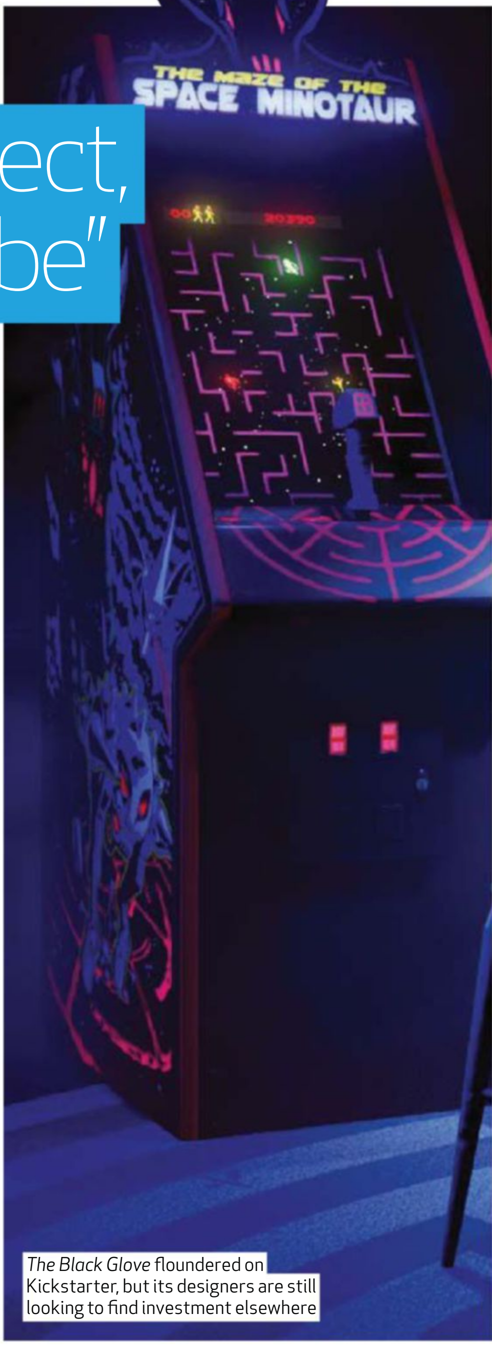
Crowdfunding can be a fickle mistress. Sometimes an idea or pitch really captures the imaginations (and, more importantly, the bank accounts) of the web-based public. The games industry has had a fairly positive relationship with platforms such as Kickstarter and IndieGoGo – everything from tiny indie projects to classic franchises returning from the grave have found life in the Lazarus Pit of the crowdfunding womb. Sometimes the very last weeks of a more ambitious project can be its most prolific; just look at PS2 classic *Amplitude*, which mashed its $775,000 goal in a matter of weeks thanks to a solid social-media campaign.

Sadly, such seismic support isn't always forthcoming… even for a concept as captivating as *The Black Glove*. Designed by Day For Night Games, a small studio made up of former Irrational Games devs, *The Black Glove* was as close a spiritual successor it was possible to get to the original *BioShock* without having a Big Daddy pop out as tour guide. It was an incredibly ambitious project, juxtaposing time travel with themes of doubt and regret, but sadly it just wasn't to be.

Even *BioShock* creator Ken Levine got behind the project. Despite not even playing the game by that point, señor Levine publicly backed the project saying at the time he had a "huge amount of confidence" in Day For Night Games and that he expected the "atmosphere of the game" was going to be "amazing." Unfortunately, the Kickstarter drive failed to meet its lofty $550,000 goal last month, raising less than half of that by its closing date. So is the bubble finally starting to burst on the crowdfunding boom? Perhaps, but *The Black Glove* failing to meet its goal with such a wave of media coverage is more telling of a shift in the delicate relationship between the ambitious plans of a developer and the financial confidence of the Joe Public.

Moving on, we do love a tasty slice of concept art here at *PC Format*. Mmm, just look at those sexy swashes of digital watercolour… We're also quite partial to the sci-fi shenanigans of the Mass Effect universe – so imagine our puckered surprise when BioWare released a slew of new artsy shots showing the Mako (as last seen in the first *Mass Effect*) trundling about some gorgeous looking new worlds. We don't even know when *Mass Effect 4* will arrive, but if its new galaxies are even half as interesting to explore as they are to look at we'll probably explode with happiness.

P76
FOOTBALL MANAGER 2015



The Black Glove floundered on Kickstarter, but its designers are still looking to find investment elsewhere

RECOMMENDED

Civilization: Beyond Earth
2K
PCF299 p62
Its foundation is familiar, but this is a game that's full of surprises and is difficult to master.
★★★★½

Alien: Isolation
Creative Assembly
PCF298 p64
The game that the Alien series has always deserved. A deep, fun stealth game set in an evocatively realised sci-fi world.
★★★★½

Wildstar
NCSoft
PCF294 p64
Clever questing and a stand-out combat system make for an entertaining MMO that is as large as it is full of character.
★★★★½

Smite
Hi-Rez Studios
PCF293 p66
An addictive game makes the lane-pushing genre more approachable with smart tweaks to the old formula.
★★★★½

Trials Fusion
Ubisoft
PCF293 p70
Fusion's thrill is not found in leaping a yawning chasm, but in the simple clearing of an overhanging ledge with efficient grace.
★★★★½

Diablo III: Reaper of Souls
Blizzard
PCF292 p64
This awesome expansion has made *Diablo III* even better, and includes some fun little goodies. We like.
★★★★½

HotWired

IN THE NEWS

A touch of Silk

Last month a huge international collaboration between the FBI and Interpol culminated with the shutting down of the Silk Road, an online black marketplace for illegal drugs (among other things). It was quite the coup for the FBI since the Bureau has been doggedly attempting to stamp out the Silk Road for years. It was originally culled in October 2013 following the arrest of its owner Robert Ulrich 'Dread Pirate' Roberts, but version 2.0 was already up and running a mere four weeks later thanks to a group of former Silk Road administrators.

The Silk Road (named after the a series of historical trade routes that run through the heart of Asia) forms a part of the internet known as the Deep Web, the portion of the web that isn't indexed by search engines. As part of this little enclave, the Silk Road enables its users to browse its illegal wares anonymously without fear of being identified.

The closure of Silk Road 2.0 also included the arrest of its main operator Blake Benthall, who had previously worked for rocket construction company SpaceX. Benthall, based in San Francisco at the time of his arrest, was reportedly also in possession of a hard drive containing encrypted customer details the Bureau intends to use in further investigations. Within hours of the news of its closure, version 3.0 was up and running.

DEPARTMENT OF JUSTICE
FEDERAL BUREAU OF INVESTIGATION
FIDELITY
BRAVERY
INTEGRITY

Despite Version 2 being taken offline, Version 3 of Silk Road is already up and running

MESSENGER MANDATE

Are you a Facebook obsessive? Well, there's probably a good chance you like to check your own feed/stalk the timeline of others while on the move, too. If both of these virtues are aligned then you're probably aware of *that* Messenger app which Facebook has forced its users to use if they intend to send private messages via the social platform. Mark 'Richer than God and JK Rowling combined' Zuckerberg recently took part in a public Q&A to address concerns over the app and said the service could "never deliver the quality of experience as just a tab inside the main Facebook app." The irony is, despite all the moaning, a *lot* of people are still using the app: 500 million active users every month, in fact. Great boycott there, guys.

HIGHLIGHTS THIS MONTH

68 Assassins Creed Unity

72 Dragon Age: Inquisition

86 Homebrew your own NAS

90 Auto backup with File History

PLAYING WITH MONEY

HENRY WINCHESTER CASTS HIS EYES OVER GAMING'S ACCOUNTANCY BOOKS TO SEE IF THE INDUSTRY IS AS HEALTHY AS IT THINKS

On 26 April 2014, a team of documentary makers turned up part of an unlikely story in the arid expanse of the New Mexico desert: a trove of some 700,000 buried Atari cartridges. The discovery of this 8-bit burial ground, assumed for many years to be little more than an urban legend, was a reminder of the near-destruction of the industry in the early 1980s.

A number of factors led to the spectacular crash. The industry was flooded with poor-quality consoles, and the home computer was emerging in the form of the Apple II, the IBM 5150 and the Commodore 64. Consumers were becoming interested in a piece of hardware they could upgrade, rather than one with features rigidly set by its manufacturer.

There were also great shake-ups within the industry itself. Atari employees, annoyed that they weren't paid royalties like their counterparts in the film and music industries, split from the company and formed Activision. Atari attempted to sue Activision for producing games for its consoles, but when the action was chucked out of court it allowed numerous other third-party companies to create games.

The result was a torrent of absurdly awful games which completely overwhelmed stores unprepared for, and uninitiated in, the ways of games. Atari didn't help matters by programming and releasing *ET* in just six weeks, resulting in one of the most notoriously awful titles in videogame history. The general public were disillusioned by the quality of games, and retailers began to write them off as a fad.

Stand in the *Shadow of Mordor* for £15 less on PC

The result was that in a matter of years a $3 billion market became a $100 million one. Companies created to make a quick buck vanished as quickly as they appeared. Games were reduced from $35 to $5, and Atari's multitude of *ET* cartridges, along with games such as *Centipede*, *Pac-Man* and *Defender*, some consoles and – allegedly – some Mindlink controllers ended up buried in that desert.

It was a massive setback for the games industry, and one which allowed Sega and Nintendo – which survived by virtue of being in the rather more savvy Japanese technology market – to gain footholds in North America. The industry, it seems, learned its lesson, and tighter controls combined with better business models have meant that despite its occasional failures, the entire shebang has never imploded on itself quite so spectacularly since.

But we should never be too careful; there are signs that the industry is heading for another catastrophe. Here we cast a magnifying glass over the industry's current performance, from the cheapest ways to buy games to the half-billion budgets companies are ploughing into them. Our quest: to find out if the market could ever crash so spectacularly again.

A SURVIVOR'S TALE

In the fall-out of the great crash the PC defiantly survived, like an irradiated cockroach. It also became a more realistic gaming platform, with industrious hobbyists creating their own games. By 1987 it had become the largest target market for games companies, and it continued to evolve incredibly quickly: VGA graphics, CD-ROM drives and sound cards meant that the desktop computer – even in its boring off-white housing – was many times more exciting than its console equivalents.

In terms of publishing, the PC around this time was still emulating the system employed by consoles. Publisher and developer were often one and the same, and it was a system that worked because publishers had enough cash to invest in potential flops without going under, and the supply and distribution networks to get games to the general public. But it also meant that smaller developers, which we'd probably now term 'indies,' were unable to get a look-in unless they'd been contracted by a publisher to create a game – which happened very rarely at the time.

The method indie developers created to circumvent publishers was ingenious. Bedroom developers would issue the full versions of their games with certain restrictions – the final act would be locked, or a parrot would kill the player character (hello, *Escape Velocity*). These versions of the games, dubbed 'shareware,' would be distributed via 3.5-inch disks mounted on the front of magazines – including the very magazine you're holding – or via mail order services.

The result was that these versions of such games spread like wildfire, an impressive feat given that the internet was only in its most nascent form, and unavailable to most. Even if a tiny fraction of players paid for and unlocked the full game it was worth it to the developers because their overheads were so low; they'd just got a million copies of, say, *Duke Nukem* into people's homes without spending a penny on marketing.

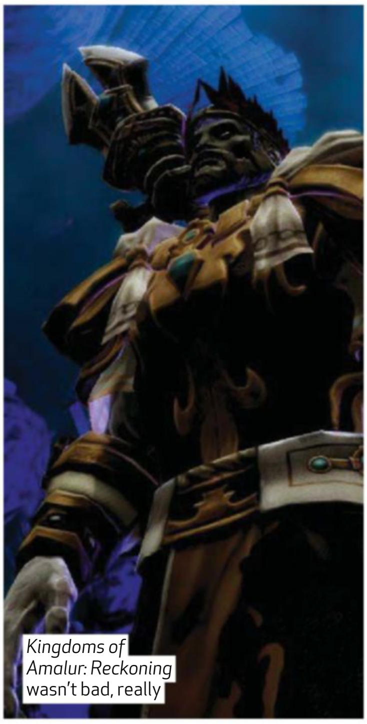
More important than the shareware distribution method was its message: the value of games didn't lie in their packaging or their marketing and advertising budgets – it lay in the lines of code which made them up, and nothing more. Again, the PC was at the forefront of this underground movement, and some of the format's most important games (*Doom*, *Wolfenstein 3D*, *Commander Keen*) were distributed this way.

> "In the fall-out of the great crash the PC survived, like an irradiated cockroach"

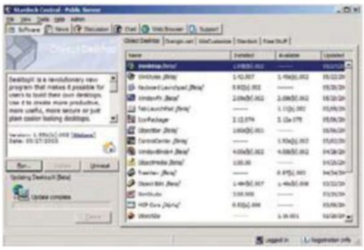
Remember *APB*? No? Probably for the best

The rise of the internet gave developers a whole new way to distribute software in the late '90s, but glacial speeds and a lack of infrastructure meant that most shareware and demoware was distributed via floppies and CD-ROMs rather than 56k dial-up.

By 2000, three per cent of US adults had access to a broadband



Kingdoms of Amalur: Reckoning wasn't bad, really



Stardock Central: this is what Steam's grandad looked like.

internet connection. Stardock, a company which published both games and Windows customisation software, was the first to offer an online marketplace, dubbed Stardock Central. It wasn't until 2004 that digital distribution really took off, though, with Amazon Digital Services, GameStop, Games for Windows Live, Origin and Steam all launching. Despite initial reservations – especially with regards to Steam, which was required to play Valve's *Half-Life 2* – digital distribution became a huge success.

GMG AND GOG

Like games themselves, digital distribution services could now have unique selling points – Green Man Gaming allowed trade-ins, Good Old Games specialised in getting older titles painlessly up and running on newer hardware, and Origin was the only place to grab EA's titles. While the games offered by these services were often the full titles, with a few demos here and there, it very much carried the spirit of shareware from the early '90s: no packaging, and word-of-mouth taking precedence over marketing. Tying in critic systems such as Metacritic meant that the way we valued games was altered drastically.

The lower requirements of digital distribution meant that these services were free to take risks. In late 2009, Valve launched the first Steam sale, with then two-year-old titles *BioShock* and *Portal* reduced to $4.99 and *STALKER: Shadow of Chernobyl* available for just $1.99. While Steam has never released stats for the sale (and never will), the internet was ablaze with people asking Steam to "shut up and take their money."

Of course, this wasn't a sale in the conventional sense – Valve didn't

OnLive and kicking

WE TALK TO BRUCE GROVE, GENERAL MANAGER AND VICE PRESIDENT OF ONLIVE, ABOUT THE GAME STREAMING SERVICE

PCF: What have been the biggest changes in the games industry in the last few years?

Digital has been changing the games industry for a while and it's not done yet. Whether you're looking at how games are delivered, the renaissance of the indie developer, the immediacy of social, or the draw of live video streams, all have been fuelled in some way by improving connectivity, and it's only going to get better. We're also seeing consumer expectations changing. People want to access their chosen entertainment quicker on the device of their choice wherever they are.

PCF: How does it work in terms of game licences/keys?

OnLive has two offerings. PlayPack is very much like the Spotify or Netflix models where you have a constantly growing library of games that subscribers can play whenever they like, wherever they like, as much as they like. We also have CloudLift, which enables you to play your games library instantly from virtually any connected device. Currently we're working with Steam games, but the plan is to support more platforms going forward. This means you own the game licences. You can play it locally if you have a suitable PC; it's the same multiplayer and community features you're used to, but now you can play it anywhere you like.

PCF: How do you think the games industry is going to change in the future?

That's an easy one: Games will come in pill form, and we'll all be playing hover- PCs. Aside from that, as fibre and 4G roll-outs continue, we expect to see more people using cloud gaming as one of the ways they access their games. Potentially, this could slow the hardware cycles because a portion of the upgrading can happen server-side. Also – and this is based on almost five years of data of this OnLive feature – live video for spectating will take on an increasingly important role in influencing the games we buy or choose to play.

Green futures

GREEN MAN GAMING'S EXECUTIVE VP OF MARKETING DARREN CAIRNS ON ITS DIGITAL DISTRIBUTION SYSTEM

PCF: The online games marketplace has changed a huge amount since Green Man Gaming started – what have you done to keep ahead?

We've kept ahead of the game by going beyond a sale! On top of having an extensive catalogue of nearly 6,000 titles, we offer customers the chance to earn GMG Credit for positive activity such as joining the service, writing reviews on the site, signing up to newsletters, or most importantly, playing games. With Playfire Rewards, we attach credit to a selection of titles. This credit is then earnt as gamers play through and gain achievements. These games don't have to have been bought from us – gamers simply need to link their Steam account and sign up to the Rewards BETA to start earning their way to new games and content.

PCF: You've recently branched out into console games – how does this market differ to the PC?

We know modern gaming audiences are no longer loyal to one platform. Nearly half of the Green Man Gaming core PC audience owns a PS3 or PS4, while 43% own an Xbox 360 or Xbox One. As our audience play across platforms, our main focus still firmly remains on the PC market which is extremely healthy, more diverse, and more relevant to the industry than ever before. In September 2014, Intel estimated the number of PC gamers to be 711m – that's a large pool to fish in!

PCF: Games funded through Kickstarter mean that indie developers can pretty much bypass having publishers and do it themselves. Is that a good thing for you guys?

It's good for everybody! The ease of being able to self-publish means there's a greater number of high-quality titles vying for attention, but many studios and developers still need help on overcoming the barrier to market entry, which is something we've have strongly been championing this year. Using our specialist retail knowledge, we've been able to draw attention to self-published titles that might otherwise have gone under the radar.

have shelf after shelf of mouldy mince pies and party frocks to flog at reduced prices. But it affirmed the idea that digital versions of games, which could be infinitely replicated (until, at least, you run out of Steam keys) and transported for next to nothing could be flogged in quantity and still turn a profit.

Others followed Steam's quietly revolutionary sale. The first *Humble Indie Bundle*, released in 2010, offered older games *World of Goo*, *Aquaria*, *Gish*, *Penumbra: Overture* and *Lugaru HD* for whatever price purchasers wanted to pay – an idea which had its roots in the pay-what-you-want pricing of Radiohead's album *In Rainbows*. It generated over $1 million in sales, developers got a fair chunk of cash, and a little money went to charity too.

Humble has since branched out into mobile formats and other media, such as audiobooks and digital graphic novels, and even hosts its own store. It also dropped the 'indie' title for bundles from bigger companies such as THQ, EA and Warner Bros. The EA bundle stands out as the most successful to date – it generated a whopping $7 million in revenue for the company, despite the fact that you needed Origin to claim the games.

Around this time broadband connections were getting faster, and powerful graphical hardware capable of quickly decoding high definition video streams was commonplace. As a result, services such as OnLive and Gaikai were able to offer game streaming with high-resolution graphics and instantaneous interaction. Initially written off as little more than elaborate parlour tricks, both systems worked, with the latter being bought out by Sony for adoption into its PlayStation Now game streaming service.

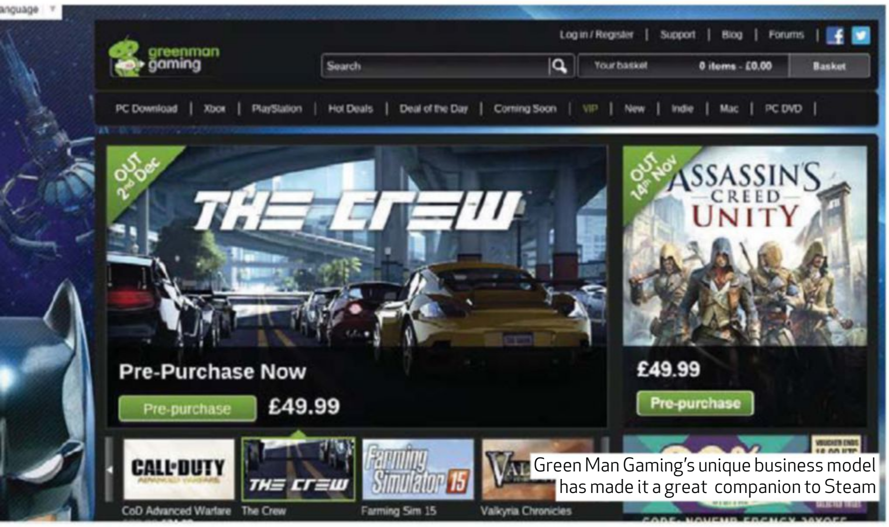
As it stands, OnLive represents a gaming version of internet entertainment services Spotify and Netflix. For £6.95 you can access 250 games, which can be streamed to any device with a screen. The service has also expanded with its CloudLift service, which allows you to play games on the cloud and download them to Steam. While OnLive perhaps hasn't been embraced by gamers in the way the founders expected it to, it has been a hit in the industry, with the majority of large studios offering games via the service.

You can still wander into a store and buy a boxed copy of a PC game, although the shelf space allocated to the medium is rapidly shrinking. PC games still have a distinct advantage over console versions when it comes to pricing: *Middle-Earth: Shadow of Mordor* is currently listed at £25 for a PC copy on Amazon, with PlayStation 4 and Xbox One versions costing about £15 more. That's on top of the numerous advantages of the PC as a flexible and cheap platform, and one which has shaken its bug-ridden image.

So that's pretty much the state of how the industry's working at the moment. It's just the tip of the iceberg, too – mobile titles make truckloads of money in a triumph

> "If just one game fails, it can drag a whole developer or publisher down"

Star Wars: The Old Republic apparently cost $500 million to make



Green Man Gaming's unique business model has made it a great companion to Steam

Total Annihilation offered DLC before the abbreviation even existed

of quantity over quality. Vast streams of money come in from licensing and spin-offs; according to Nielsen BookScan, Minecraft books alone are a £2.5-million-a-year industry. And boxed software, predominantly released for consoles, is still the biggest revenue stream in the UK industry, valued at £998 million in 2013. However, digital and online games are fast catching up, with £819 million spent last year.

FAIL(ED)

With such vast amounts of money coming in it's incredibly hard to see how anything could ever go wrong. But this is a turbulent, immature industry. Since the industry began, 614 companies have been declared bankrupt; games with huge budgets and talented crews can completely flop, and for every successful console there's been a handful of out-and-out failures.

However, we haven't actually seen many of these failures for a few years. *APB* and *Kingdoms of Amalur: Reckoning* were the last major gaming flops; THQ was the last company to go bankrupt. While it's great that no-one has lost their livelihoods for a while, and that games seem pretty much guaranteed to make their investments back, this can lead to one of the worst things for the industry: confidence.

Every major stock market disaster, from the 1929 Wall Street crash to the 2008 financial crisis has come about, in part, due to overconfident investing. If investors believe they're putting money into a sure thing, this can lead to a rapid growth in credit and loans, and suddenly publishers are treating $10 million games like $100 million ones. Games require more investment than ever before, with *Star Wars: The Old Republic* rumoured to have cost more than $500 million to produce.

The stakes, therefore, are a great deal higher. If one game fails, it can drag a whole developer or publisher down with it – and this is exactly what happened to *Kingdoms of Amalur*'s creators Big Huge Games and 38 Studios in 2012. A bigger studio, such as Activision Blizzard, could be brought to its knees if *Overwatch* flops.

The industry has certainly learnt its lesson thanks to the sheer number of consoles on the market leading up to the crash of the 1980s; the last console to be considered a failure was Sega's Dreamcast, but Sega cannily repositioned itself as a software company. The final piece of the puzzle is the games themselves. Afraid to take risks with massive investments, publishing companies are tending to play it safe with sequels and spin-offs. The problem here is that gamers will be put off if identikit titles are released year after year.

The elements for another crash are there, even if the industry is too varied and too huge to ever fail quite as catastrophically as it did in the early 1980s. But nothing is ever permanent. Maybe 30 years from now, hundreds of thousands of Steam keys will be found buried in the Mexico desert… ■

A Twist in the Tale

THE UK INTERACTIVE ENTERTAINMENT ASSOCIATION'S CEO DR JO TWIST GIVES US HER THOUGHTS ON THE INDUSTRY

PCF: Tax relief was introduced earlier this year – is it already having an effect on the UK games industry?

The tax breaks scheme officially came in on April 1st 2014, and we have been touring the UK with our tax breaks roadshow since then to make sure all developers know about how to make their claim.

The initial response has been incredibly positive. We encourage as many businesses as possible who think they might be eligible to take a look at the Cultural Test to see if they might qualify for any development costs from April 1st 2014 .

PCF: Does piracy still have an effect on the way the games industry works financially?

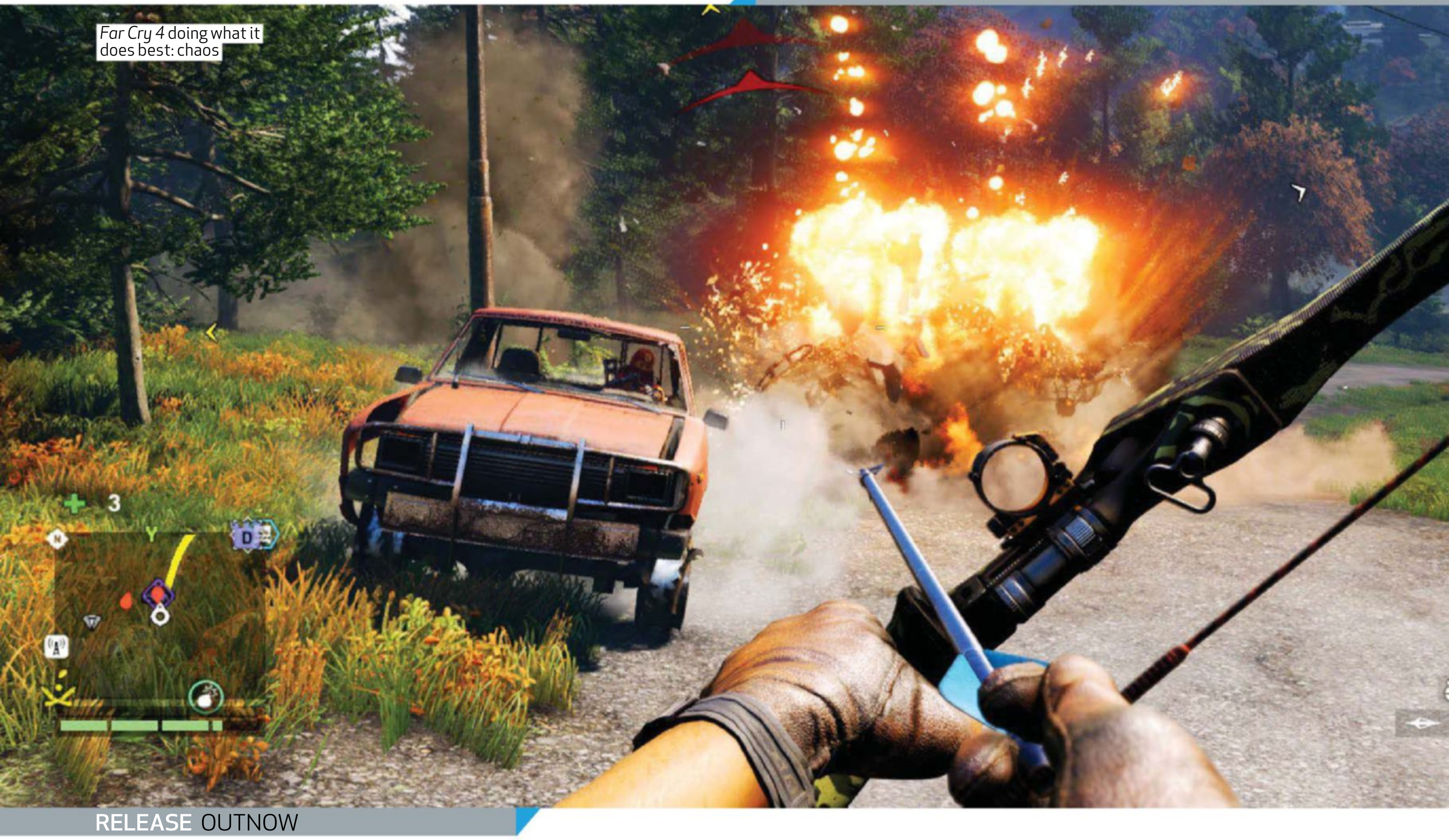
The games industry has always been very good at dealing with this issue in different ways to other sectors. Games deal with it through diversity of business models, having the best relationship with its community of fans and potential fans, as well as giving access to games when players want it.

It is still an issue for PC games in particular, but it is interesting to see how models such as Early Access can change the landscape.

PCF: The games industry is becoming more and more lucrative every year – is there any danger that it'll completely crash?

As an industry we keep going from strength to strength – but the data on digital sales, compared to boxed sales, is still not consistent and public enough, which does not help us tell our story as a sector. On a yearly basis, games beat music and film sales in the UK, and we are growing even faster as a sector globally.

We are in the era of content creators, and barriers to entry have never been lower. Games are at the forefront of innovation and creativity and we are the blueprint for a creative digital economy – but we must learn to be agile and flex in order to remain as such.



Far Cry 4 doing what it does best: chaos

RELEASE OUTNOW

Far Cry 4

Swap sandy beaches for snowy Himalayan mountains, with vertigo-inducing results

Ajay Ghale travels to Kyrat, a fictional region of the Himalayas, to scatter his mother's ashes. But by a quirk of fate he finds himself in the service of the Golden Path, an army of freedom fighters founded by his late father. They're locked in a brutal civil war with Pagan Min, the despotic ruler of Kyrat, and it's up to you – the prodigal son – to free it from his tyranny.

It's a neat twist on the classic *Far Cry* setup. You are, as in earlier games, a tourist stranded in an exotic, dangerous place, but this time you have a more personal reason for being there. Ajay feels more like an empty vessel for the player than the last game's frat boy Jason Brody, but you still care about his story, because he's propped up by a memorable cast, including the two feuding leaders of the Golden Path, Amita and Sabal.

But let's take a moment to talk about Kyrat itself. This is a stunning landscape of fog-shrouded mountains, forested valleys, shimmering rivers and rolling plains. While *Far Cry 3*'s Rook Island was vividly bright and colourful, here the palette is muted and autumnal. The Himalayan flora and fauna give it a very different feel, and it reminded me a lot of *Skyrim* in places. The map is large and open, but flanked by towering, snow-capped mountain peaks, and the scenery and atmosphere change subtly as you travel from the lowlands to the highlands. It's just a beautiful place to exist in.

VITAL STATISTICS

- **Price** £40
- **Developer** Ubisoft Montreal
- **Publisher** Ubisoft
- **Web** far-cry.ubi.com
- **Multiplayer** Competitive, co-op
- **DRM** Uplay
- **Recommended spec** GeForce GTX 970, Intel i5-3570K @ 3.40GHz, 16GB RAM

Bear thrills

It's also an insanely entertaining playground. I've had more fun here than I ever did in *Far Cry 3*'s tropical archipelago. Kyrat is full of sheer drops, mountains, cliffs and deep valleys. It's remarkably varied and vertiginous, which lets you take full advantage of the wingsuit – now available straight away.

Gyrocopters have also been added, and they're a lot of fun to buzz around in. There are new land and water vehicles, such as hovercraft and hilariously rickety tuk-tuks, but you'll spend most of your travel time in the air. The grappling hook is another new addition, which Ajay can use to clamber up or abseil down vertical surfaces and swing across gaps. You can only attach it to pre-defined points, though, which is slightly disappointing.

Wildlife is an important part of the series, and Kyrat is teeming with exotic creatures, most of which want to kill you. There are elephants, rhinos and black bears, monkeys, honey badgers and eagles. This abundance of fauna makes your surroundings feel brilliantly alive, and random animal attacks are a constant source of amusement. Tigers will pounce on you, eagles grab you with their talons, elephants flip your car over, and killer bees swarm over you – sometimes simultaneously. But, equally, animals will attack your enemies, often to your advantage.

Like *Far Cry 3*, the game is split between story missions and outposts. The missions are bombastic, scripted and large-scale, like an absurd action movie,

There are more ways than ever to traverse the map

When you play co-op, your pal appears as this guy

"Look what I found… can we keep him? Can we?"

You'll grow to love the new gyrocopters

Visit the House of Chiffon to start hunting rare animals in Kyrat Fashion Week quests
First-person elephant ahoy

while the outposts give you the opportunity to really play with the game's systems. Both are entertaining in their own way, but it's during outpost raids where things get really good.

How you approach and wipe out these enemy-controlled areas is up to you, and the game gives you a huge amount of tools to play with. Games often boast about player freedom when really all it amounts to is either shooting everyone noisily or shooting everyone stealthily; but the scope for creativity in *Far Cry 4* is often intoxicating – provided you have an imagination. The new fortresses are mega-outposts, filled with tough enemies and alarms.

Instant fail? Fail

Of course, this being an Ubisoft game, there are a million other icons littering the map. Some of these are fairly standard open-world fare, such as checkpoint races and collectables, but others are worth your time. The House of Chiffon challenges, where you hunt rare animals for a creepy fashion designer, are a highlight – particularly the one where you go fishing by dropping C4 into a lake from a gyrocopter. Map-revealing towers are back, and each presents a unique platforming challenge. There's loads to do.

All of this – barring story missions – can be played with another person in co-op. This is one of the most enjoyable multiplayer experiences I've had for a while, and having another person on hand when assaulting an outpost only expands the already vast amount of ways to clear them. I didn't experience any issues, but I have heard cases of people being kicked out and losing progress.

Far Cry 4's biggest weaknesses lie in its scripted missions. Amazingly, despite seemingly everyone hating them, *Assassin's Creed*-style tailing missions have made it into the game. There are also far too many insta-fail stealth bits. These are never fun – and totally at odds with the open-ended freedom of the outposts.

There are some really great moments in the story – especially your first trip to the dreamlike Shangri-La – but I can't help but feel the campaigns in these games should be built around the outpost missions, and not separate, scripted entities. It's here where the game and its interacting systems really shine.

Another issue – but one I quickly got over – is familiarity. *Far Cry 4* is quite obviously an iteration of *Far Cry 3*, rather than any kind of progressive sequel. But then I loved *Far Cry 3*, so I don't care about that. There are more toys to play with, the world is more fun to traverse, the story is infinitely better, and everything just feels tighter and more focused. ■ **Andy Kelly**

PCFormat Verdict

An absurdly entertaining open world playground that's at its best when you break away from its scripted missions.

★★★★½

A detailed and elegant city that's not without its flaws

RELEASE OUT NOW

Assassin's Creed Unity

Explore Assassin's Creed Unity's beautiful, broken city at your peril

Paris in 1798, what a time to be alive. The streets are filthy with mud, blood and gunpowder smoke. Starving citizens bully perceived enemies of the state to the guillotines. Guards clash with roaming anarchists. Above, you see burning effigies and spiked heads. Below, the Tricolour is stamped into the dirt.

Assassin's Creed Unity recreates all this with astonishing clarity in an incredibly detailed city, which you explore to unlock missions. The professional killer in this adventure is Arno Dorian, a devilish young rogue born of wealth. He's quickly driven into the Assassin order by personal tragedy, and uses his remarkable skills of stabbing to seek revenge and win the affection of his childhood friend, Elise. Naturally, there's also a convoluted plot involving the battle between the Assassins and the Templars, who are both manipulating the revolution for increasingly confusing reasons.

This is complicated slightly by the return of the ongoing *Assassin's Creed* metaplot. In this game you're playing a VR product produced by the evil Abstergo company, who are searching for the death site of a certain figure in Arno's life. The best thing about this is it's delivered in brief and infrequent cutscenes and voiceover skits from a couple of characters based in the present day. No longer are you pulled out of your exciting assassin adventures to roleplay a more boring person.

VITAL STATISTICS

- **Price** £40
- **Developer** Ubisoft
- **Publisher** In-house
- **Web** www.bit.ly/assunity
- **Multiplayer** Up to 4 player co-op, when it works
- **DRM** Uplay
- **Recommended spec** Intel i5 3.4GHZ CPU, GTX970, 8GB RAM, 41GB HDD

Murder à la mode

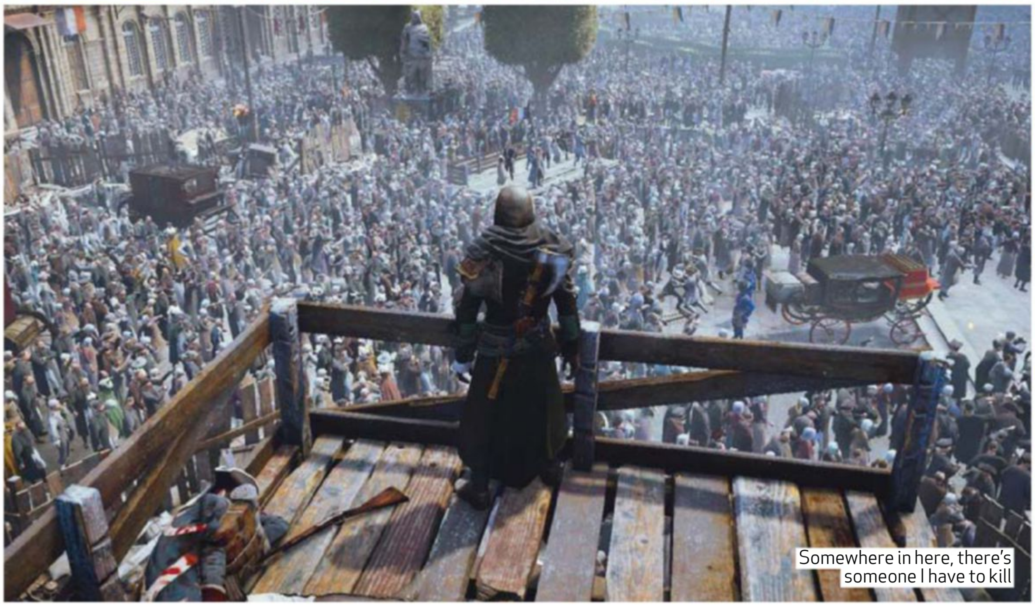
Your targets are hidden away in sandbox locations – castles, prisons, palaces – that you have to crack like puzzles. At the start of a mission, Arno assesses the area to pick out gaps in the defence. When the mission starts, you're free to find your way in and go to the target. These missions are facilitated by a new stealth system. *Unity* finally has the crouch-walk the series has always needed, which means you can dart between cover spots without standing upright in full view like a gleaming beacon of guilt. There's also a clunky cover system (which is fiddly to use), and a new weapon: the phantom blade – a wrist-mounted miniature crossbow that lets you kill targets silently at range or send them berserk to cause a distraction.

The assassinations may be good, but the campaign is padded out with set-up missions. While these are generally fine, you're still following NPCs along rooftop routes, stealing things from guarded areas, tackling thieves and saving civvies from criminals. The focus on everyday assassin business also puts more pressure on the core traversal systems, and while the freerunning moveset has been expanded for *Unity*, it can't quite handle the crooked geometry of Paris.

There are now separate commands for freerunning up and down buildings, which is useful, but movement in all directions lacks precision. Simply climbing into a window can be tricky. Attempting to climb a lumpy object like a market stall will cause moments of mid-air shivering. Arno gets stuck on small boxes and street detritus.

Expect plenty of postcard moments like this

He's guilty. Just look at that villainous top hat


Somewhere in here, there's someone I have to kill

Use Eagle vision to highlight your target's route

Sorry, my axe slipped

Descending from a rooftop to a balcony is based on guesswork. Most of the time things work well, but for a game that's so reliant on traversal, there's too much frustration. The system can make leaps and spins look beautiful, but it often fails to divine the player's intent while executing the flair.

Combat has been refreshed too, with good intent but mixed results. The counter button has been replaced by a parry command. Time the parry and Arno will execute a countering blow that puts the enemy off balance and opens them up to follow-up strikes and brutal kill moves. Arno can only suffer a few blows himself before being spiked, and can easily be shot to death.

Combat should feel dangerous, but it shouldn't feel quite so out-of-control. Ubisoft have said the new combat system is inspired by fencing, and while it has a little of the back-and-forth parry-riposte structure, it's sluggish. Button presses can seem lost amid long, complex animations. On the plus side there's quite a bit of variety to the weapons – you can fight with swords, spears, polearms, axes and clubs, and even rifles, which Arno uses as shooty clubs in close combat. You can buy these with in-game money or with real money via a microtransaction system… Fortunately it's easy to ignore this, but the same can't be said for the in-game chests and items that tie into *Unity's* Companion App and Initiates webgame.

Super-bugs

Unity is only recommended if you have a great graphics card. It's fluid and gorgeous on a GTX 970, but on mid-range cards such as a GTX 670, expect low and choppy framerates that worsen during cutscenes. While my experience has been relatively clean, *Unity* is rife with widely reported bugs.

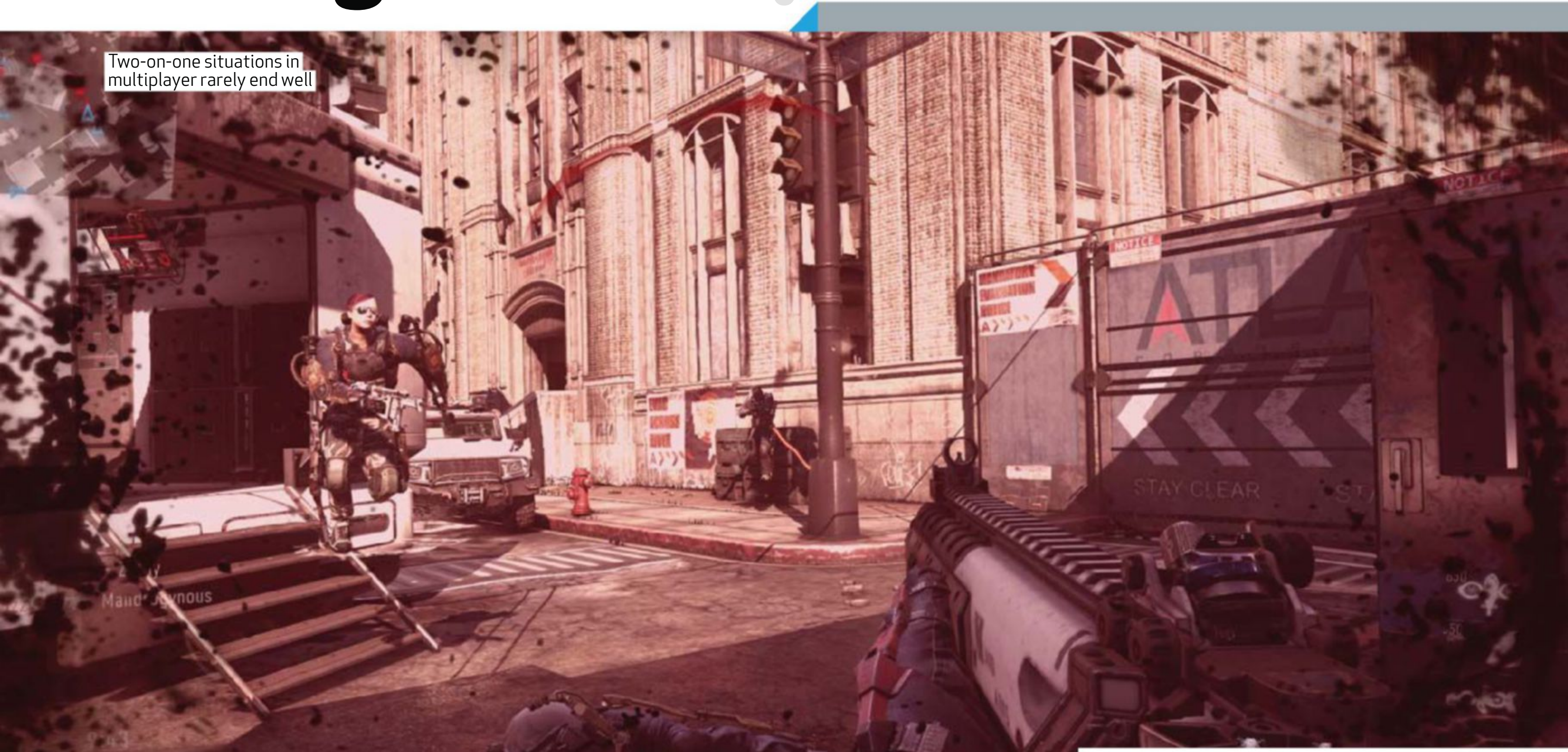
The other huge failure is co-op. The new mode lets you summon up to three friends into your Paris to run around exploring, or to engage in a collection of heist and assassination missions. I almost had fun coordinating attacks with friends in these varied and lengthy missions, but not one co-op game has passed without a disconnection error, a wrongly placed objective marker, a target not spawning, or numerous other mission scripting errors. It just doesn't work.

If patched properly, *Unity* could become an enjoyable part of the *Assassin's Creed* canon. It's a solid campaign elevated by quality assassination missions and a setting that might just gain this game an extra star. But with a big selling point out of operation, technical issues, performance problems, microtransactions and stilted combat and freerunning, *Unity* – in its current state at least – should only really be considered a failed revolution. ■ **Tom Senior**

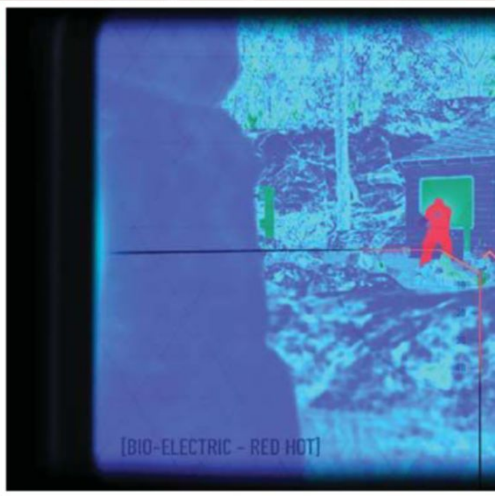
PCFormat Verdict

A magnificent city full of exciting assassination missions, marred by broken co-op and technical issues.

★★★☆☆



Two-on-one situations in multiplayer rarely end well



RELEASE OUT NOW

Call of Duty: Advanced Warfare

A futuristic but familiar military shooter drones on

Call of Duty: Advanced Warfare's campaign is a first-person shooting gallery smattered with nearly-on-rails vehicle segments, quicktime events, and slightly interactive storytelling. It's like the last seven *CoD* games, then.

It certainly is a lot better than *Ghosts*, though, and it introduces some neat near-future gadgets. The most interesting are the Exo suits, which imbue their wearers with double-jumps, strafe dashes, and other special abilities.

Guns are everywhere and fun: big, powerful, varied, some punching single shots through armour, others spraying corridors with death. The ballistics aren't very interesting but the animations and sounds are addictive. There's even a beam weapon – like a *Ghostbusters* proton pack, only it extracts ghosts from the living – and it's disgustingly satisfying.

I'm a walking, running, jet-jumping massacre, then, but all that power is constricted by a greater power: the script. There are moments when *Advanced Warfare* snaps the rigidity typical of *CoD* campaigns – a brief, unguided stealth section and a fantastic grappling hook that I was allowed to use freely a couple of times – but outside of those I was rarely asked to solve any problem, other than who to shoot first.

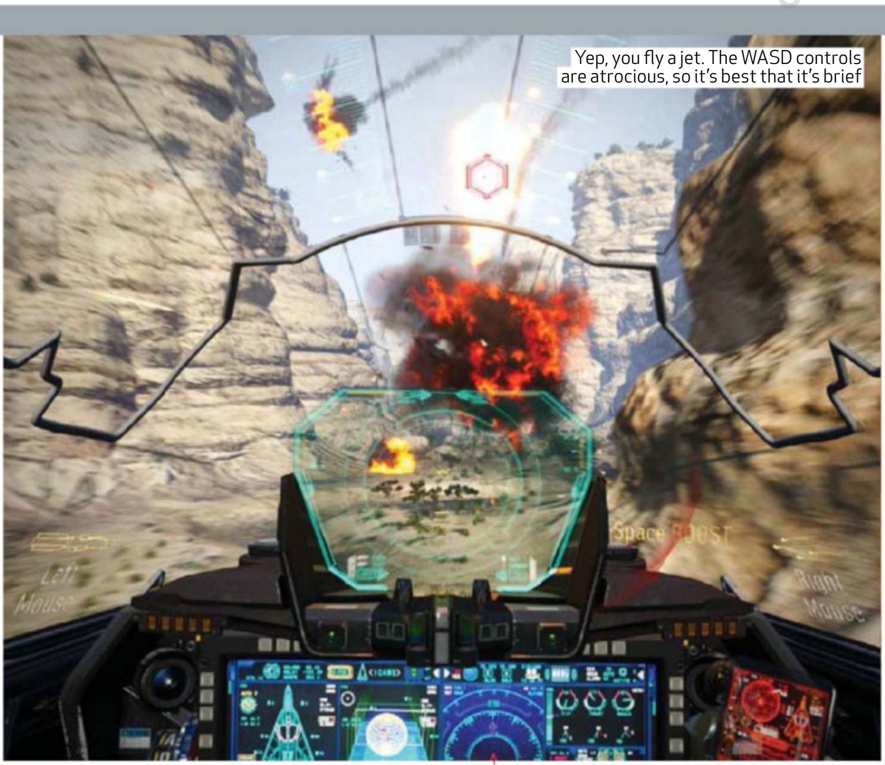
AW's eight-hour campaign was actually really hard to put down, though. With the help of Kevin Spacey in a lead role, it tells an enjoyably simple, predictable story of power and corruption. I didn't care a lot about it, but it was an effective way to push me into increasingly improbable scenarios: hopping between buses on a freeway, clinging to a jet with magnetic gloves as it flew over Antarctica, speeding away from assailants on a hover bike. It was impossible to be bored when I was doing something new and extravagant every ten minutes.

Despite a few ugly textures, this is by far the best-looking *CoD* too. The Antarctica level in particular is gorgeous, with glowing ice caves and great windy plains of snow. My biggest complaint is that *Warfare* slacks on some of the basics. I was always faster than the squadmates I was supposed to follow, and always reached our destination first. They gestured to me over their shoulders while I was standing in front of them, then barked at me to open the door I'd been standing next to the whole time. I got stuck in the geometry once while under attack from a sniper… and so on.

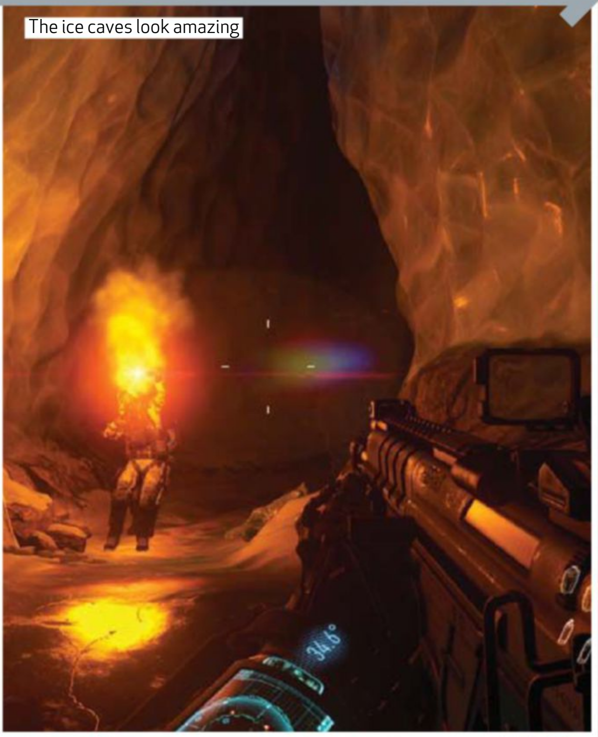
The story conclusion didn't even feel worth it. I enjoyed Kevin Spacey's performance, but I didn't grow attached to any of the characters, or really give a damn about who lived or died.

VITAL STATISTICS

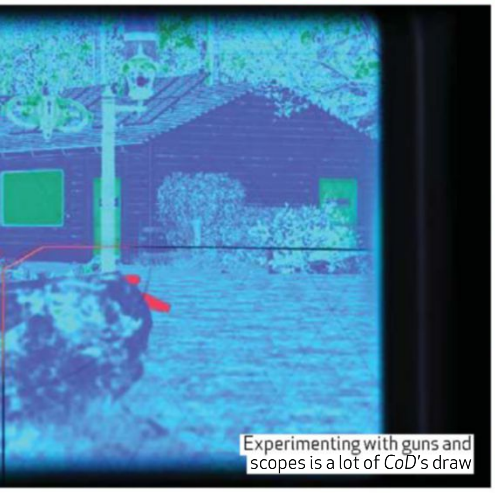
- **Price** £40
- **Developer** Sledgehammer Games, Raven Software
- **Publisher** Activision
- **Web** www.callofduty.com
- **Multiplayer** 4-12 player online competitive and 'horde' style co-op
- **DRM** Steam
- **Recommended spec** Core i7-4770K, 16GB RAM, GTX Titan Black



Yep, you fly a jet. The WASD controls are atrocious, so it's best that it's brief



The ice caves look amazing



Experimenting with guns and scopes is a lot of *CoD*'s draw

Did they mention Kevin Spacey is in it? Kevin Spacey. Kevin Spacey

Things get pretty dark…

Enhanced warfare

AW's multiplayer is much better than *Ghosts*', too. The weapons are more fun to handle, the maps more colourful, interesting and better designed, and the progression system far superior.

The Exo suits, with their jet-assisted double jump, are useful for getting to the high ground in a hurry, and occasionally for getting out of fire through a high jump. They do make for fun cat-and-mouse chases. They also have special abilities, such as cloaking and hovering. These are unlocked along with special grenades and weapon attachments as you earn experience and ranks – as usual.

New equipment, however, is now also unlocked in 'supply drops' acquired during matches. Like a *Team Fortress 2* crate, these gift you surprise new guns and gear.

I like that I can customise the look of my soldier; I like looking cool. More importantly, there are now weapon variants to collect, so while there are only six assault rifles, for instance, there are multiple versions of each. The guns are fun to use and there's a nice variety, though some feel superfluous.

My biggest complaint about all the guns is that, while getting used to their stats and bullet spread is interesting, their animations are dull and simple, and there aren't many moving parts. They do have distinct personalities, it's just hard to see it.

Warfare still doesn't rank highly for me among other multiplayer shooters. *Rising Storm* has fidelity, and generates the best stories, *CS:GO* offers tension and nuanced tactics, *Titanfall* is great casual fun, and *Team Fortress 2* has the best community. *CoD* remains a churning sea of adolescent sharks for whom new players are chum. The first several hours of learning are frustrating as hell, so thank goodness for the new Combat Readiness Program, which is a dumb but sweet way to learn anonymously with beginners while you learn the ropes.

I played round after round, hoping for the next unlock, but I never really enjoyed it. The past week doesn't feel enriched by all the *CoD* I've been playing. I don't have any exciting stories or fun anecdotes for instance; I ran and shot and got shot. I could have spent the week getting smashed at a bar and I'd feel pretty much the same about how I spent my time. ■

Tyler Wilde

PCFormat Verdict

The campaign is mostly predictable, dumb fun, the multiplayer some of CoD's best – but still with all the old shortcomings.

★★★⯪☆

The gang nominate Cullen to complain about the slow service in the restaurant

RELEASE **OUT NOW**

Dragon Age: Inquisition

This might be the biggest game in the series, but is it the best?

With *Dragon Age: Inquisition* – an enormous RPG and third in the series – developers BioWare has created a rich and broad history, much of which shapes what happens in the game. It's initially overwhelming, as names of people, places and events are tossed casually into the narrative. My advice? Stick with it. *Inquisition* takes you on a long and satisfying journey, with plenty of time to work out what's what and who's who.

The game opens in the village of Haven. It's ten years after the events of *Dragon Age: Origins*, a few weeks after the epilogue of *Dragon Age 2*, and the exact moment that the Temple of Sacred Ashes is destroyed in a blast of unknown origin. Inside, the head of the Chantry – the world's main religious organisation – was attempting to negotiate peace between the warring Templars and mages. Where the temple once stood, there is now only a dangerous and growing vortex that threatens to engulf the world. You are the only survivor. And who you are, depends on the character you create. There are four races to pick from: human, dwarf, elf or hulking grey Qunari. Whatever your choice, you're a curiously humanised Inquisitor.

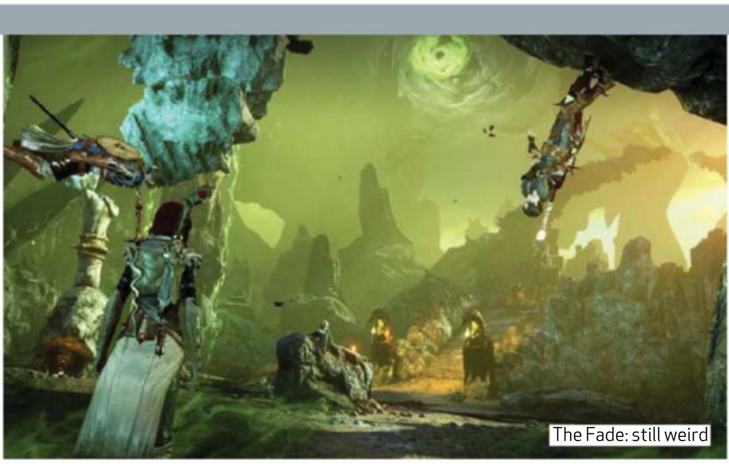
VITAL STATISTICS

- **Price** £40
- **Developer** BioWare
- **Publisher** EA
- **Web** www.dragonage.com
- **Multiplayer** Up to 4
- **DRM** Origin
- **Recommended spec** Nvidia GTX 670, 8GB RAM, i5-3570K CPU

Seeking closure

The breach is the story bridge that links the political posturing of the world's factions to your own need to venture out and kill things. Closing it requires power, and that, initially, means securing the support of either the mages or the Templars. To approach either, you'll need to increase the *Inquisition*'s support – by completing quests. Check something off your to-do list, and you're awarded Power and Influence. Power lets you unlock new areas and progress the story, while Influence unlocks perks.

The first main area you unlock is the Hinterlands. It's an enormous expanse, filled with hills and cliffs, and crammed with nooks and crannies hiding secrets, sidequests and lush, verdant scenery. Not all areas are this big, though. The city of Val Royeaux is a mere marketplace square, used for only a handful of quests throughout the campaign. Then there's The Fallow Mire, which acts as an almost standalone undead vignette across a mostly linear area. Predominantly, though, you'll be charting massive, open spaces, each offering a distinct environment and ecosystem. Some, like the forests of the Emerald Graves, are beautiful – filled with wild and vibrant plant life in a multitude of primary colours. The most populated area of the game is the Inquisition's headquarters. You'll return here



The Fade: still weird

So the big green hole is bad, yeah?

How to fight a dragon: perforate legs, avoid teeth

You can turn on friendly fire, if you want mages to kill everyone constantly

between missions to talk to companions, assign tasks to advisors, and optionally behead the odd criminal or two.

Advisors offer personal quests and will chat between missions. However, unlike your companions, you can't take them out into the field. Instead they can be summoned to the War Council, to be given tasks through a map view of Ferelden and Orlais. Each assignment can be tackled through diplomacy, intrigue or military force, with different results and completion times depending on the advisor used. Once assigned, a timer ticks down, after which you can collect your reward.

Ram raider

Inquisition's sidequests vary, and the worst resemble MMO fetch quests. To counterbalance this, the main story missions are distinct, memorable, and significantly move the story along. The story also provides *Inquisition's* few instances of lengthy, linear combat encounters. The combat system has been significantly changed for this incarnation. You still have *Dragon Age's* classic trio of Warrior, Rogue and Mage – each with multiple skill trees to further define the role. Now, though, the emphasis is on direct attacks, using the left mouse button to swipe away at enemies between activation of the skills assigned to your hotbar.

For the most part, it works well, but, be warned, there are persistent minor annoyances. I played as a rogue, and found the combat animations too slow. You can avoid a lot of damage by dodging the heaviest, most telegraphed enemy strikes, but your movement is limited while attacking. Targeting enemies can be troublesome, too. There are few things more frustrating than activating your Inquisitor's leaping strike, only for her to vault off in the wrong direction because the game hasn't registered you're attacking the enemy in front of you.

Control over the party's tactics has been simplified. In previous games, orders resembled absurd algebra puzzles. If Morrigan drops below 25% health, should she turn into a swarm of insects? Sure, but only if she stops being insects at lesser than or equal to 50% mana. In *Inquisition*, you have some agency over when healing items are consumed, but skills can only be enabled, disabled or marked as preferential – giving them priority over other skills.

Controlling Inquisition's party requires accepting the inefficiencies of the AI, or spending a lot of time micro-managing. Choose the latter, and you'll find the tactics battle screen – used to assign orders to the party members you're not currently controlling – has its own issues, all of which are with the camera. It gives you a top-down view of the battlefield, but is awkward to move and doesn't zoom out quite far enough.

The biggest combat change is in how healing works. Mages can no longer cast restorative spells, and characters don't regenerate health between fights. Instead, your entire party has a shared pool of potions – eight initially, with the possibility of upgrading. These can only be restocked at the camps you set up out in the world, or from supply caches found scattered along the path of a main mission. It's a decent system, and completely changes how battles are arranged. For one thing, difficulty is no longer tied to the number of enemies, but rather is down to their composition. Even when fighting three or four bandits, the presence of a shield-carrying Templar can provide a significant challenge. Gone too are the long crawls through enemy-infested caves. Most battles are against small and often avoidable groups out in the open world, with spelunking a limited and often short distraction.

Inquisition is filled with moments that make it such a fulfilling and worthy sequel for the series. The heartwarming interactions with those companions I befriended. The brief touches of humour and levity. The way that, through the Dragon Age: Keep website, my decisions across the previous games have been woven into the fabric of this one. My first fight with a dragon – the way its animations perfectly conveyed arrogance, annoyance, and eventually exhaustion – will be one of my most enduring gaming memories of this year.

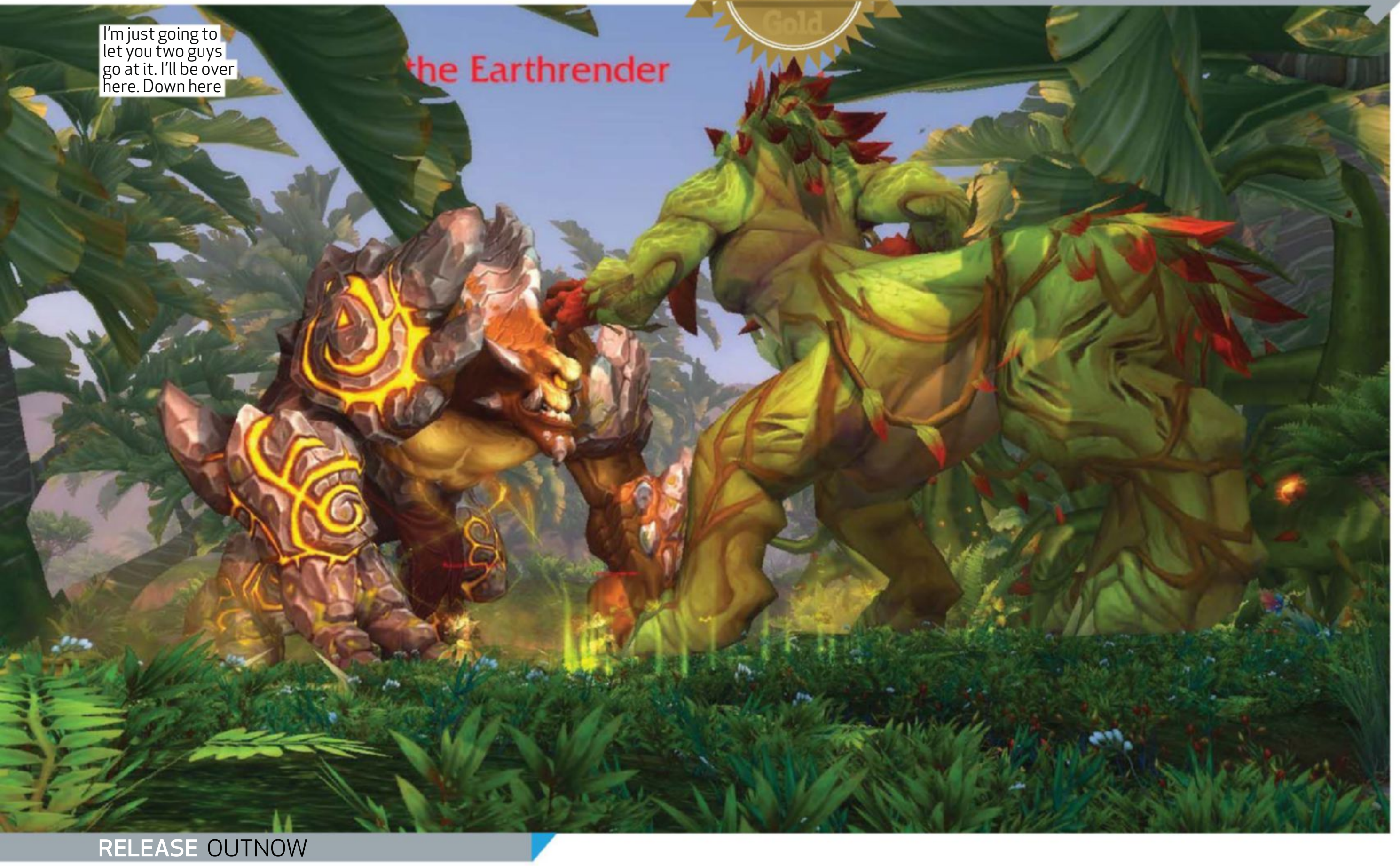
There's even co-op multiplayer, in the style of *Mass Effect 3*'s horde mode, although that won't be for everyone. It doesn't affect a singleplayer campaign that, all things considered, is a resounding success. How much you enjoy *Inquisition* will likely depend on what it is you enjoy about RPGs.

If you want complex systems and hardcore challenge, it could potentially disappoint. I have to admit, I don't. I want a rich world, interesting characters, and a dramatic and memorable plot. Judged on those criteria, *Dragon Age: Inquisition* sits alongside BioWare's best. ■ **Phil Savage**

PCFormat Verdict

A fantastic campaign and massive open environments, soured only slightly by minor, persistent flaws.

★★★★½



I'm just going to let you two guys go at it. I'll be over here. Down here

RELEASE OUTNOW

Warlords of Draenor

Revisit the good old days of *World of Warcraft* in the latest expansion

W*arlords of Draenor* is Blizzard going back to its roots, if hardly back to basics. Orcs. Humans. The raw power of the Horde, in a land of blood and fire. It's also some of the best MMO content Blizzard has ever made, combining the raw ambition we saw in *Wrath of the Lich King* with the expertise earned from another six years of practice, refinement and technological progress.

The plot centres on the world of Draenor, before it became Outland as seen in *Burning Crusade*. The evil Warchief Garrosh Hellscream is [insert token and interchangeable MMO plot here].

Anyway, you're now officially one of Azeroth's heavy-hitters. Where once some random guard in a nowhere outpost could have you go get him lunch, now you're given proper respect wherever you go. Soldiers cheer when they see you approach, and you have full control of your faction's main garrison.

This garrison acts as home for the expansion, but it's also a functioning base. Where once you were piled with meaningless crapwork by uncaring leaders, now you get followers and the power to give them the crapwork – or to have them join you in the field as your bodyguard. As your base grows, you unlock more plots to build on and additional buildings.

The whole system is simple but effective, the physical presence of recruited followers and the general sense of life making it feel like your own place despite everyone using the same instanced map. It's a very Blizzard addition.

VITAL STATISTICS

- **Price** £30 (£10 subscription)
- **Developer** Blizzard
- **Publisher** In-house
- **Web** eu.battle.net/wow
- **Multiplayer** Massively
- **DRM** Online only
- **Recommended spec** i7 CPU, GTX 970, 4GB RAM

Draenor shine

As a setting, Draenor might sound like Outland revisited. In practice, they're worlds apart; same place, very different time. From the ice and lava of Frostfire Ridge to the overgrown fungus that litters its swamps and the quiet beauty of Shadowmoon Valley, this is a beautiful place. Only Nagrand feels like a return visit, and even that has been given a massive upgrade, with huge cliffs and grass fields.

Throughout the expansion, there's a tacit acceptance that balance in singleplayer PvE is utterly irrelevant, and that players are more likely to stick around if they have a good time. Thus you get a free boost to level 90 to begin with, while levelling is fast, clever and full of fun and variety – in fact I actually felt sad when I dinged 100.

It's still *WoW*, though. There are bear asses to collect and ten of whatnot to kill, and nothing you encounter is going to cause any real trouble. There's no ignoring that it's a game from 2004 and its mechanics increasingly creak compared to more modern MMOs, but it still manages to give us a journey that is a triumphant return to form. ■ **Richard Cobbett**

PCFormat Verdict

Familiar, but more polished than ever. A powerful reminder of why no MMO has ever taken *WoW's* rusty crown.

★★★★½

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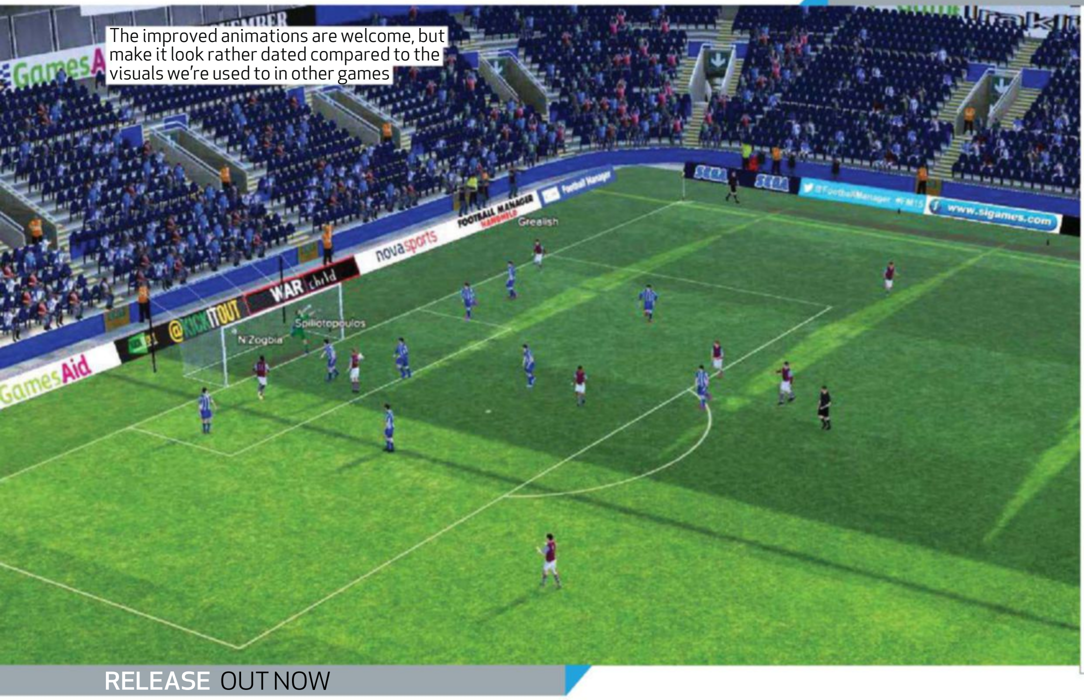
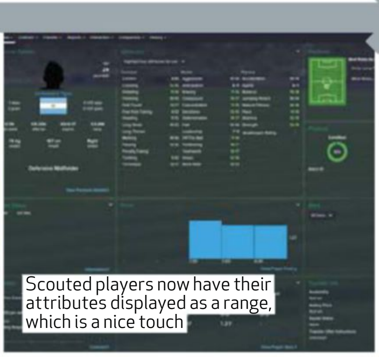
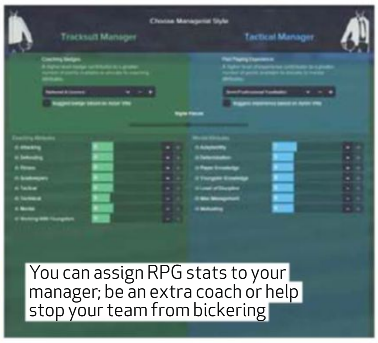


The improved animations are welcome, but make it look rather dated compared to the visuals we're used to in other games



Scouted players now have their attributes displayed as a range, which is a nice touch



You can assign RPG stats to your manager; be an extra coach or help stop your team from bickering

RELEASE OUT NOW

Football Manager 2015

After the light-heartedness of last year's Classic mode it's back to the hardcore…

Sports Interactive is in a spot of bother. Not necessarily with *Football Manager*, but with football itself. With every other yearly franchise the devs can come out with a brand new hallmark feature, a new setting, new characters, something that can differentiate one year's game from the previous. SI can't really do that with *FM*; football itself doesn't fundamentally change year on year and I know it doesn't want to start simulating the brazen corruption of FIFA, the morally-questionable millionaire 20-somethings or the dodgy gambling practices of the less salubrious side of the game.

That in turn means in order to make the latest game feel *that* different, Sports Interactive would essentially have to start from scratch. That can sometimes be a very good thing indeed, but when SI has honed the fine details of its football world simulation so well that real managers admit to using the game as a scouting tool, it's almost throwing the baby out with the bathwater time.

The trouble with that is when little seems to have changed with a new release you will always get the accusations this latest full price game is little more than a data update. SI argues there have been many small, iterative improvements under the bonnet, but the game still feels perilously close to a skinned version of *FM 2014*.

You will, though, notice an improvement in the overall UI. It's a little more uniform in its layout, allowing you to more easily navigate to key pages, but will require returning players to relearn as smaller features have shifted around. You'll also see a difference when you get into the match engine – something I found more jarring than a few misplaced screens.

SI has introduced more animations into the game and improved the visuals of the pitch and the various stadia. My problem is that the more SI refines its in-game graphics, the more out of date they seem. Where they once had the feel of an accurate, strategic representation of a football match (you can still go for that 2D view if you want) they're increasingly looking like a buggy freeware version of *Actua Soccer*. The animations are the same whether you're in a muddy hole in the Vanarama Conference or gracing the Bernabeu.

But the match engine itself has been improving constantly since I first started playing this version a few months back, and will continue to do so until the usual Christmas update, which often seems to fix many a post-release foible.

The Classic mode remains almost unchanged for the more casual players looking for the sim without the time-sink, and the full game feels even more in-depth with the extra little feature tweaks. Some players have complained about the new scouting system being slow, but it's made me play more like an actual manager, necessarily using the trial system to get a bead on potential free agents, rather than suddenly knowing every skeleton in their closet overnight. Like other annoyances in the game though – such as the constant drag of press conferences – you can turn them off or get your staff to deal with them.

But do we have a better game this year? I'm going to say yes, but again it's slight evolution not revolution. The noob hand-holding help system is a very welcome addition and the Classic mode is great for when real life takes over your time. The actual core of the game is still great too, though there are parts that need a refresh to halt *FM's* increasing yearly stagnation. ■ **Dave James**

VITAL STATISTICS

- **Price** £35
- **Developer** Sports Interactive
- **Publisher** Sega
- **Web** www.footballmanager.com
- **Multiplayer** Online and hotseat
- **DRM** Steam
- **Recommended spec** Intel Core 2 Quad Q6600, 8GB RAM, GeForce GTX 570

PCFormat Verdict

Almost frustratingly familiar, but the iterative improvements make the hardcore game even more of an in-depth experience.

★★★★☆

Future

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HOW TO BE A TECH GURU

THE ANCIENT ART OF SOLVING ANY COMPUTER PROBLEM

Expert' is a relative term – by which I mean it's a term that our relatives use. "Ask Luis, he's the computer expert," my mother-in-law will say, to anyone who will listen. I've spent more than twenty years fixing other people's problems, so I'm used to being called an expert, but the reality is that every family has its own expert.

To qualify, you just need to be the youngest adult in the room that owns a PC. Sooner or later, your grandma or your uncle or your sister-in-law will mention that their laptop is broken or iTunes keeps crashing, and you'll feel guilted into taking a look at it. Whether or not you ultimately manage to fix it makes no difference; you'll still be the computer expert. After all, you've just spent a frustrating Sunday afternoon downloading drivers or booting in and out of Safe Mode, so you must know what you're doing.

But this is no way to live. Nobody wants to be that sort of expert; it's not effective and the hourly rate is terrible. There are people who actually enjoy pointlessly fiddling with computers, but you aren't one of those people and neither am I. What we both want is to spend the minimum time fixing computers, and the maximum time actually using them. It doesn't matter whether you are fixing your own computer, doing a favour for a relative or even fixing computers professionally; the goal is always to find the quickest, simplest fix that works.

That's the difference between an expert and a guru. A guru can listen to a long, rambling list of unrelated symptoms and decide which ones need fixing and which ones don't. A guru knows how to Google quickly for the right answer. A guru understands when to spend time on a problem and when to spend money. Most importantly, a guru doesn't spend his spare time swapping RAM or reinstalling Windows – he spends it playing PC games. A guru enjoys all of the kudos of being an expert, with none of the hassle – and I am going to teach you how to be one.

"There is no 'weird old trick' that Microsoft doesn't want you to know about speeding up your PC"

Let's start with your own PCs. You need two: a desktop and a laptop. The laptop should be cheap and the desktop should be mid-range. You may be tempted to combine the two and get an expensive laptop: don't. The desktop is for games, which means you need a large monitor, a respectable graphics card and CPU, and good speakers. If you try to do this on a laptop, you will end up paying far more for the same performance – and using an external monitor, speakers and mouse on a laptop, just turns your laptop into an unwieldy desktop. You also want to be able to upgrade the graphics card once during the working life of a games PC, and this is all but impossible to do with a laptop.

Once you free your laptop from gaming duties, you can get by with a £400 model that will do all the workaday tasks, like sofa surfing, email, word processing and spreadsheets. This ring-fences the activity most likely to cause computer problems (that is, gaming) from all the other things you need a computer for, and it means that whichever one breaks, you've got another one to use for Googling solutions.

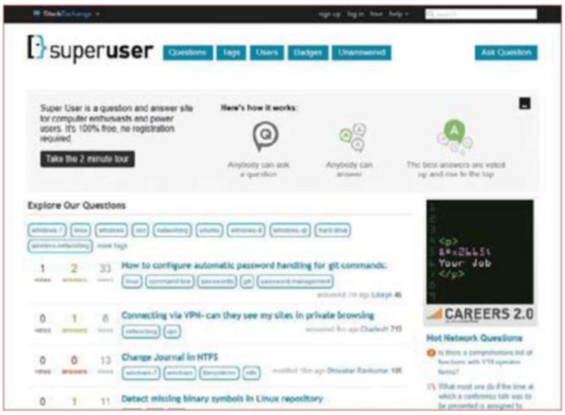
Put the desktop PC on the table, not the floor and turn the case so that it faces sideways. If you have it with the front facing towards you, like most people do, the rear becomes a stagnant tangle of cables that never gets dusted. Some of that dust will get pulled back into the case and coat your motherboard, which means the poor clearance interferes with case ventilation.

Back up both of your PCs once a month without fail. These should be complete clones of the entire hard disk using Acronis True Image (£40, acronis.com) onto an external USB drive that is at least as large as the internal drive in your PC. Use a different backup drive for each PC. Don't keep your documents on the internal hard disks at all. Put them in cloud storage, like Microsoft OneDrive, Dropbox or Google Drive. This entirely saves you from the responsibility of backing up those small, important, frequently changing files, which is most of what you need a backup for in the first place. Those clone drives are just there for disaster recovery.

SURPRISING ADVICE

If you're giving advice to others, then you should tell them, "don't build your own computer." Ten years ago this was a good way to learn how a PC was put together, but from a support perspective you're just making things hard for yourself. It's also much harder to claim on the warranty when something doesn't work, because all the manufacturers will blame each other for any incompatibility.

Don't ever reformat and reinstall Windows. This is the last apple at the bottom of the troubleshooting barrel. It takes ages, the PC is never quite the same afterwards and it doesn't fix the problem. If you are desperate enough to reinstall Windows, you are desperate enough to get a new PC – which *will* fix the problem. Don't update your drivers, either. I know that this is the first item on



Super User is a question and answer site for computer enthusiasts and power users. It's 100% free, no registration required.

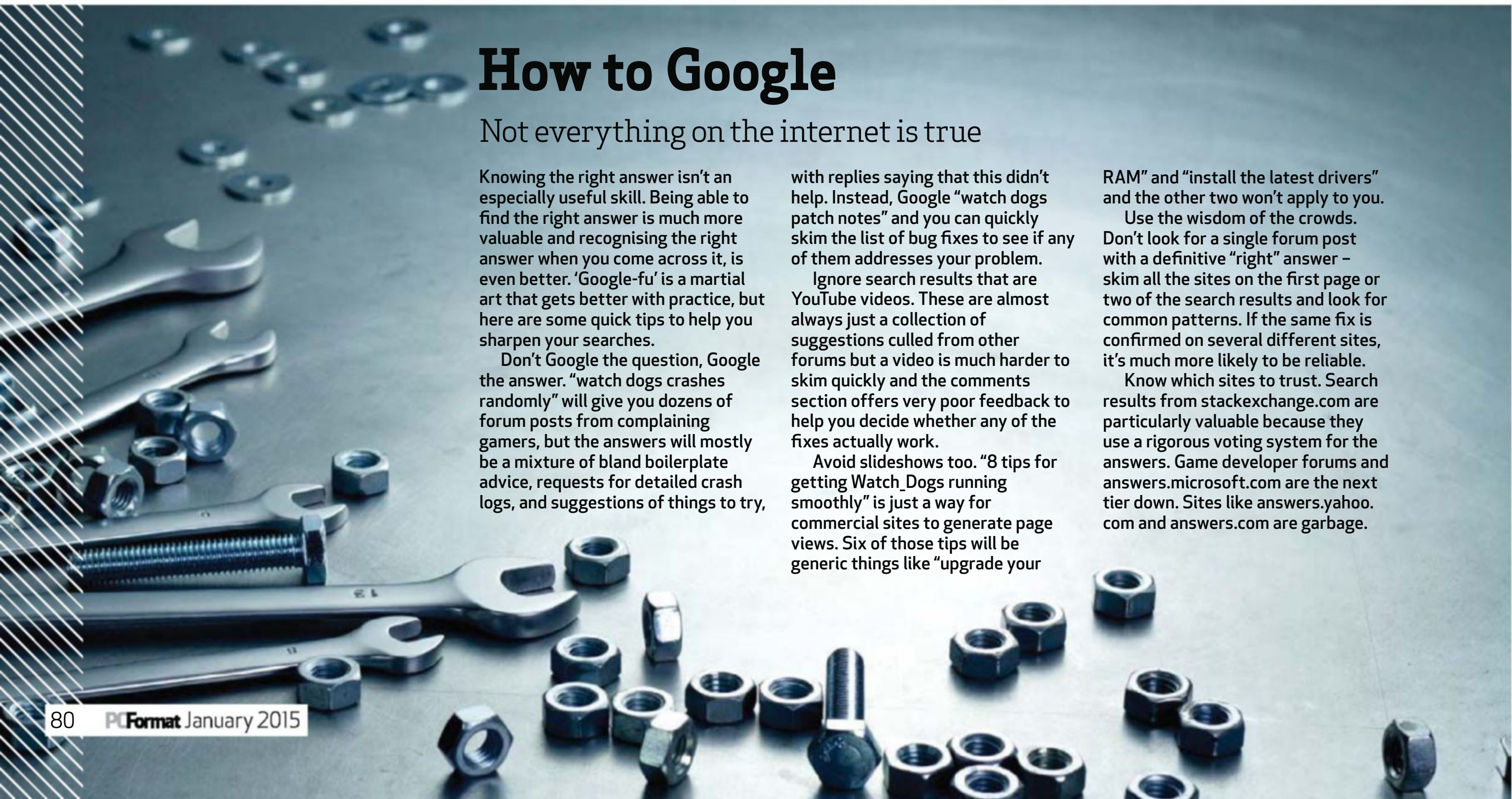
How to configure automatic password handling for git commands:

Connecting via VPN- can they see my sites in private browsing

Change Journal in NTFS

Detect missing binary symbols in Linux repository

The answers at StackExchange can usually be trusted



How to Google

Not everything on the internet is true

Knowing the right answer isn't an especially useful skill. Being able to find the right answer is much more valuable and recognising the right answer when you come across it, is even better. 'Google-fu' is a martial art that gets better with practice, but here are some quick tips to help you sharpen your searches.

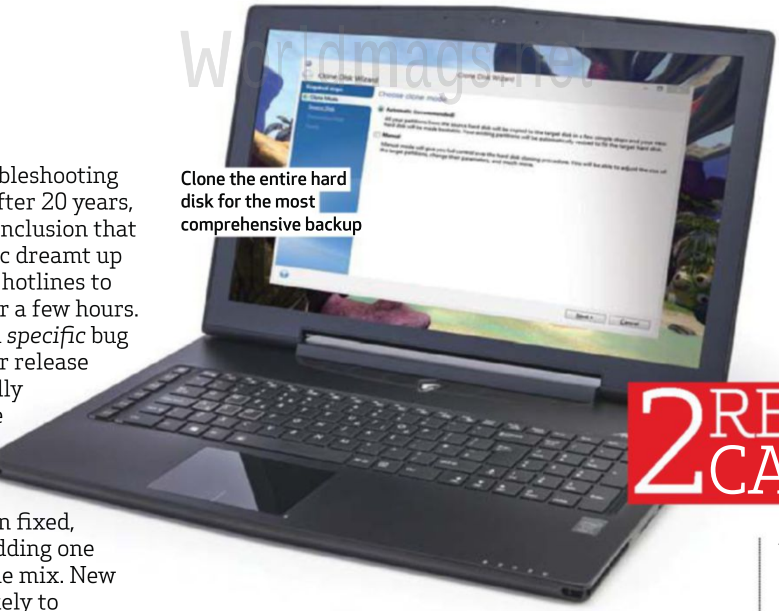
Don't Google the question, Google the answer. "watch dogs crashes randomly" will give you dozens of forum posts from complaining gamers, but the answers will mostly be a mixture of bland boilerplate advice, requests for detailed crash logs, and suggestions of things to try, with replies saying that this didn't help. Instead, Google "watch dogs patch notes" and you can quickly skim the list of bug fixes to see if any of them addresses your problem.

Ignore search results that are YouTube videos. These are almost always just a collection of suggestions culled from other forums but a video is much harder to skim quickly and the comments section offers very poor feedback to help you decide whether any of the fixes actually work.

Avoid slideshows too. "8 tips for getting Watch_Dogs running smoothly" is just a way for commercial sites to generate page views. Six of those tips will be generic things like "upgrade your RAM" and "install the latest drivers" and the other two won't apply to you.

Use the wisdom of the crowds. Don't look for a single forum post with a definitive "right" answer – skim all the sites on the first page or two of the search results and look for common patterns. If the same fix is confirmed on several different sites, it's much more likely to be reliable.

Know which sites to trust. Search results from stackexchange.com are particularly valuable because they use a rigorous voting system for the answers. Game developer forums and answers.microsoft.com are the next tier down. Sites like answers.yahoo.com and answers.com are garbage.



Clone the entire hard disk for the most comprehensive backup

just about every troubleshooting flowchart ever, but after 20 years, I have come to the conclusion that this is a stalling tactic dreamt up by customer support hotlines to get you to go away for a few hours. Unless you know of a *specific* bug in your current driver release that you are personally experiencing and the release notes for the new version explicitly mention that this bug has been fixed, all you are doing is adding one more variable into the mix. New drivers are just as likely to introduce new bugs as fix old ones, so higher version numbers aren't necessarily better.

With this foundation laid, your PCs will definitely never ever break or crash. When they inevitably do anyway, you will find that all computer problems fall into one of five categories.

1 SPONTANEOUS BREAKAGE

"It was working fine until I dropped it"

The first category is for computers that abruptly transition from working to not working. This could be the entire computer refusing to boot up at all, or it could be that you can't connect to Steam, or maybe Watch_Dogs has scrambled textures. It doesn't matter *what* stopped working, the important part is that it stopped suddenly.

Spontaneous Breakage is the easiest problem to diagnose; it occurs because something changed. Either a hardware component failed or you added something that was incompatible with the rest of the machine. Identify the last time you can definitely say that the PC was working, and the problem must lie with something that changed since then. Uninstall any new software or restore your PC back to the previous full backup and see if the problem goes away. Then repeat any Windows updates and reinstall programs one by one until it returns, just to make sure.

If you haven't added anything to the PC recently and it broke anyway, then you can be sure that a hardware component has failed. If the PC won't boot, you can usually tell which component is dead by how far into the boot sequence the PC gets (see the boxout for the normal sequence of events on page 85). But if you aren't sure, you should just replace the RAM, PSU, graphics card and hard disk – in that order. This is so that you check the easiest components first, not the most likely. Your assessment of likelihood is probably wrong, and you'll save time in the long run if you get into the habit of checking the easy things first. You might think that a game with messed-up textures can only be caused by a faulty graphics card, but RAM and PSU faults can both cause this as well, and they are both much cheaper to replace.

Inevitably, you'll end up replacing some perfectly good components unnecessarily this way. So you should always buy upgrades, rather than exact replacements. That way, all your wrong guesses are at least upgrading your PC along the way – and you can hang on to the parts.

2 REPRODUCIBLE CALAMITY

"Every time I try, it just crashes"

If you can reliably crash an application or generate one of those error messages that end-users were clearly never meant to see, then congrats! You have found a bug.

Finding bugs is a well-paid job for some people, so if you enjoyed finding it, you should consider a career in software Quality Assurance – but bear in mind you have only found one so far, so don't get too carried away. There is generally nothing you can do about a bug except report it to the developers (if they give you an easy way to do this, of course) and hope and/or pray that it gets fixed in the next version.

In reality, this is rather like voting in a general election: it's your duty to do it, but it doesn't actually make any difference. In the meantime, you'll just have to work around the bug, but at least you don't need to waste any more time looking for a solution. After all, most of the developers won't, either. (That's satire, that is.)

crucial
store memory storage community support
Two ways to find compatible upgrades

No one ever made their PC worse by adding more RAM

Avoiding the experts

How to avoid being fobbed off and brow-beaten by the well-meaning clueless

The guy in the shop is not a computer expert; he's just someone with good interpersonal skills who knows his way around the basics. If your mum wants to set up her Gmail account in Windows Live Mail, he can help. If you come to him with your weird Blue Screen error, you'll be given some misleading flannel and then steered towards a sale.

The woman in the call centre is not a computer expert, either. She's working from a troubleshooting flowchart of simple solutions to the most common problems. Her goal is to get rid of you as quickly as possible, so she can keep her call stats up. These are not bad people, they just aren't the droids you're looking for.

The truth is that there aren't really any experts anywhere. There are just people who have come across the same problem as you, and people who haven't and are guessing loudly. To be a Tech Guru you need to start filtering out this noise. The only reason for visiting a computer shop is to see if you like the keyboard action on a specific laptop. The only reason for ringing a customer support line is for billing enquiries and refunds, or for problems with your broadband connection. Everything else you will fix for yourself, armed only with the internet.

Online is actually the only place you are likely to come across honest answers. In the real world the people who know them are tucked away doing well-paid jobs far away from grubby customers. But online you can get their help for free. Don't waste time soliciting it directly though; just skim the forums for similar questions and triangulate the suggestions from the most well-informed replies. If your problem is common enough, someone else will already have asked. If it isn't, then you won't find the answer by posting.

3 CREEPING BADNESS

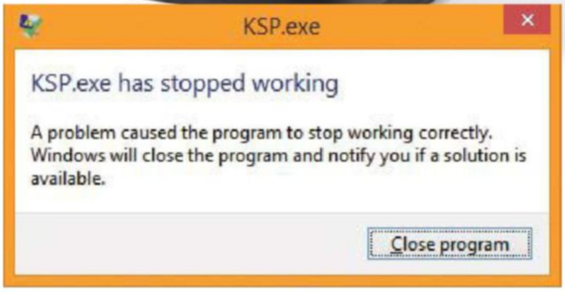
"It's just getting worse and worse"
'Badness' nearly always means that your PC is getting slower. And normally, the solution is just to put up with it. I *know* that's not what the internet tells you. But like promises of youthful skin and powerful erections, the solutions offered on the internet to speed up your PC are all scams for the feeble-minded. There is no 'weird old trick' that Microsoft doesn't want you to know about for speeding your PC up. Microsoft is extremely invested in making your PC run as well as possible, and if removing old entries from the Registry made a significant difference, Windows would already do it for you automatically.

You can make your PC run a little faster by upgrading your RAM to the maximum it supports, removing programs from the start-up group (especially your antivirus software) and uninstalling programs you don't need. But most of the slowdown comes from the inexorable bloating from Windows updates building up over time. If you want a noticeably faster PC, buy or build a new one.

The other thing people complain has got worse over time is the heat output – especially from a laptop. Older laptops run hotter because they are trying to run newer games on older hardware, so the CPU and graphics card are running at full power more of the time. They also have collected some dust on the motherboard and on the fan blades, which interferes with cooling. You can't do anything about the former, except upgrade, and I'd argue that you shouldn't do anything about the latter either. I have never dismantled a laptop and felt that things were in better shape afterwards.

If your laptop is running hotter than it used to, try not to use it on the bed, where the duvet is going to block the vents, and hope that the graphics card doesn't blow before it comes time to upgrade. Remember, heat by itself isn't really a problem.

Don't try and level your PC up, like a character in an MMO



Abrupt game crashes are usually bugs in the game or its mods

KSP.exe

KSP.exe has stopped working

A problem caused the program to stop working correctly. Windows will close the program and notify you if a solution is available.

4 RANDOM WEIRDNESS

"Sometimes it just freaks out for no reason at all"

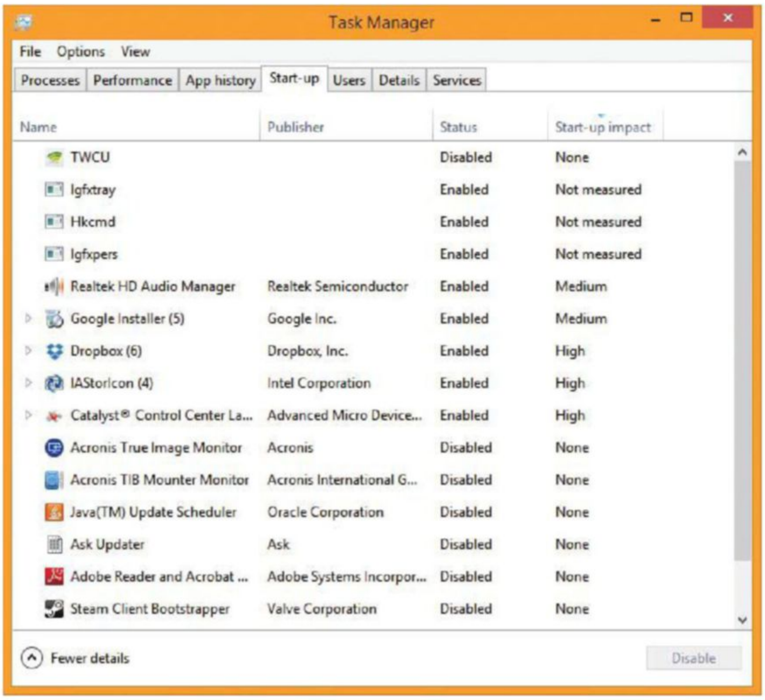
There are three kinds of random fault: loose connections, overheating and memory errors. You can tell the difference quite easily. If it freaks when you pick it up, it's a loose connection: some component or wire internally isn't quite making the connection it's supposed to be, or at least isn't doing it reliably.

If it freaks when you have been watching movies or playing games for a while, perhaps accompanied by overly enthusiastic fan noise, it's overheating. Everything else is a memory glitch. You can fix memory glitches by replacing your RAM and the other two kinds usually can't be fixed, so you should just replace the RAM anyway, in case you were wrong about which kind you have.

Random weirdness that happens only extremely occasionally isn't worth doing anything about. For instance, if my PC reboots itself spontaneously once a week, I would rather take a few calming breaths and get on with my life than waste several days hunting down a fault that is extremely hard, if indeed possible, to reliably reproduce.

On the other hand, if it reboots five times a day then this is frequent enough not to count as random at all, and more to the point it's damned annoying. You can treat this sort of fault as Spontaneous Breakage and take appropriate measures by referring to that section.

If your laptop runs hot while gaming, that's quite normal



Task Manager
File Options View
Processes Performance App history Start-up Users Details Services
Fewer details
Disable

Name	Publisher	Status	Start-up impact
TWCU		Disabled	None
Igfxtray		Enabled	Not measured
Hkcmd		Enabled	Not measured
Igfxpers		Enabled	Not measured
Realtek HD Audio Manager	Realtek Semiconductor	Enabled	Medium
Google Installer (5)	Google Inc.	Enabled	Medium
Dropbox (6)	Dropbox, Inc.	Enabled	High
IAStorIcon (4)	Intel Corporation	Enabled	High
Catalyst® Control Center La...	Advanced Micro Device...	Enabled	High
Acronis True Image Monitor	Acronis	Disabled	None
Acronis TIB Mounter Monitor	Acronis International G...	Disabled	None
Java(TM) Update Scheduler	Oracle Corporation	Disabled	None
Ask Updater	Ask	Disabled	None
Adobe Reader and Acrobat ...	Adobe Systems Incorpor...	Disabled	None
Steam Client Bootstrapper	Valve Corporation	Disabled	None

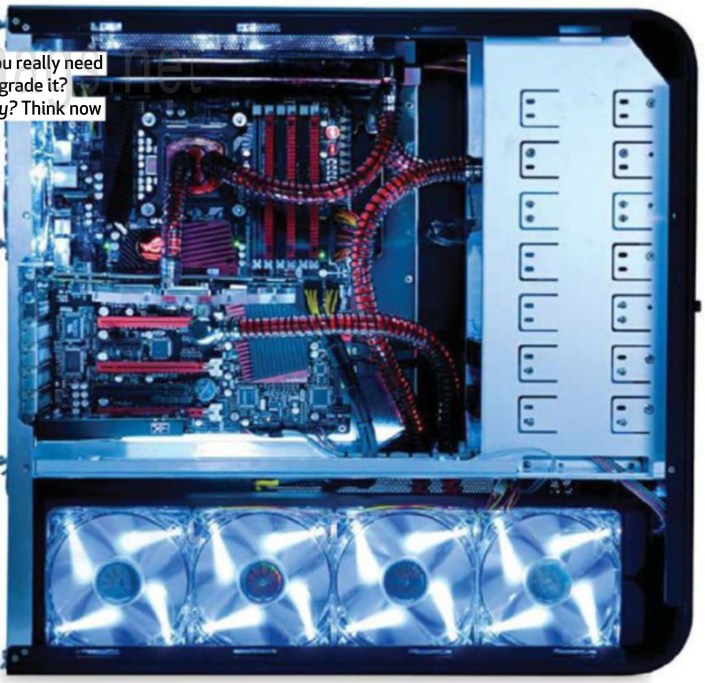
Removing start-up junk is one of the few go-faster tips that works

5 OMINOUS PORTENTS

"I'm sure I'm infected"

When people come to me for computer advice, I have learned to listen to the symptoms, not the diagnosis. Some people are convinced that their PC is constantly under attack and see every unexplained behaviour or error message as evidence of a virus infection or a hacker. If you are one of those people then stop it! Provided that Windows is updating automatically and you have changed the admin password on your broadband router from the factory default, avoiding viruses and hacking is mostly a question of not being an idiot when you click links.

If your browser home page has changed by itself, or you can't open google.com, then you've probably got a browser hijack. This is malware, but it isn't a virus and it isn't Ebola. Download the Microsoft Malicious Software Removal Tool and be done with it.



Do you really need to upgrade it? *Really?* Think now

BONUS CATEGORY
RAINBOW CHASING

"I just want to try out the latest cool thing"

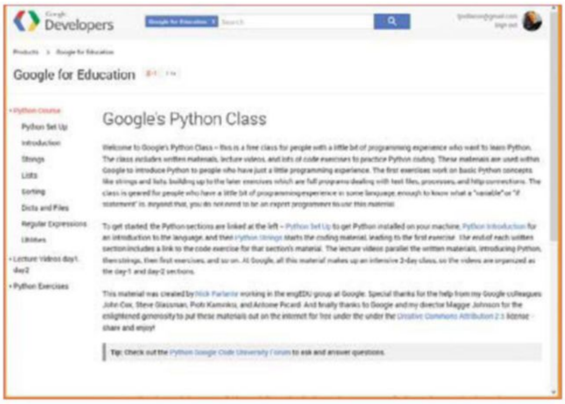
A PC is like a character in an MMO. When you start at level 1, you fight wolves and gradually you upgrade your equipment and can take on several wolves at once. But no matter how powerful you become, there will always be new gear you could get, and Chromium Ultra-wolf Den Mothers that you could be fighting. Rainbow-chasing is when you make life hard for yourself by trying to fix problems that don't exist. Overclocking your PC, just to get a bigger number in your benchmarking tool, say; or configuring a RAID0 array of disks, when hard disk performance isn't even a bottleneck for you. A lot of "What's the best way to upgrade?" type of questions are examples of Rainbow Chasing.

Upgrading is generally a good thing but there are two pitfalls you need to watch for. Don't upgrade your PC for the sake of it. You should upgrade so that you can run new software that exists now, not so that you'll be ready for any new software that might come along in the future. You can't tell how long it will be before something comes along that you need new hardware for – and by the time it does, your upgrade might not be graded far enough up. Secondly, you need to know when to upgrade the components and when to upgrade the PC.

Here's what I do. With every other version of Windows, I will buy a new desktop or laptop with that version preinstalled. On the odd-numbered releases of Windows, I'll just upgrade the existing machine. When I buy a PC, I'll specify one notch above the current mid-range for CPU and graphics card, and get the maximum RAM that Windows currently supports. I normally get whatever the default hard disk size is at the time. After a year, if I want to run an application that needs more RAM or a faster graphics card, I'll upgrade. If it needs a faster CPU, I'll get a whole new PC. I have never run out of disk space on any PC ever.

A very common question for a Tech Guru is "Which new graphics card/laptop/motherboard do you recommend?" And the correct answer is to look at the latest slew of supertests in the excellent magazine you're holding right now. We regularly cover graphics cards, motherboards, CPUs and look at full systems and laptops once a year. This leaves the question of how much you should pay for such things. The right price for a graphics card is £200. For a laptop,

Learning Python is straightforward, useful and free



Google's Python Class

Learn to program

It's like Pilates for your brain

Programming is an extremely helpful skill for a Tech Guru. Lots of command line operations become easier if you know a little programming, particularly in Linux – but much more importantly, it teaches you what a computer really is.

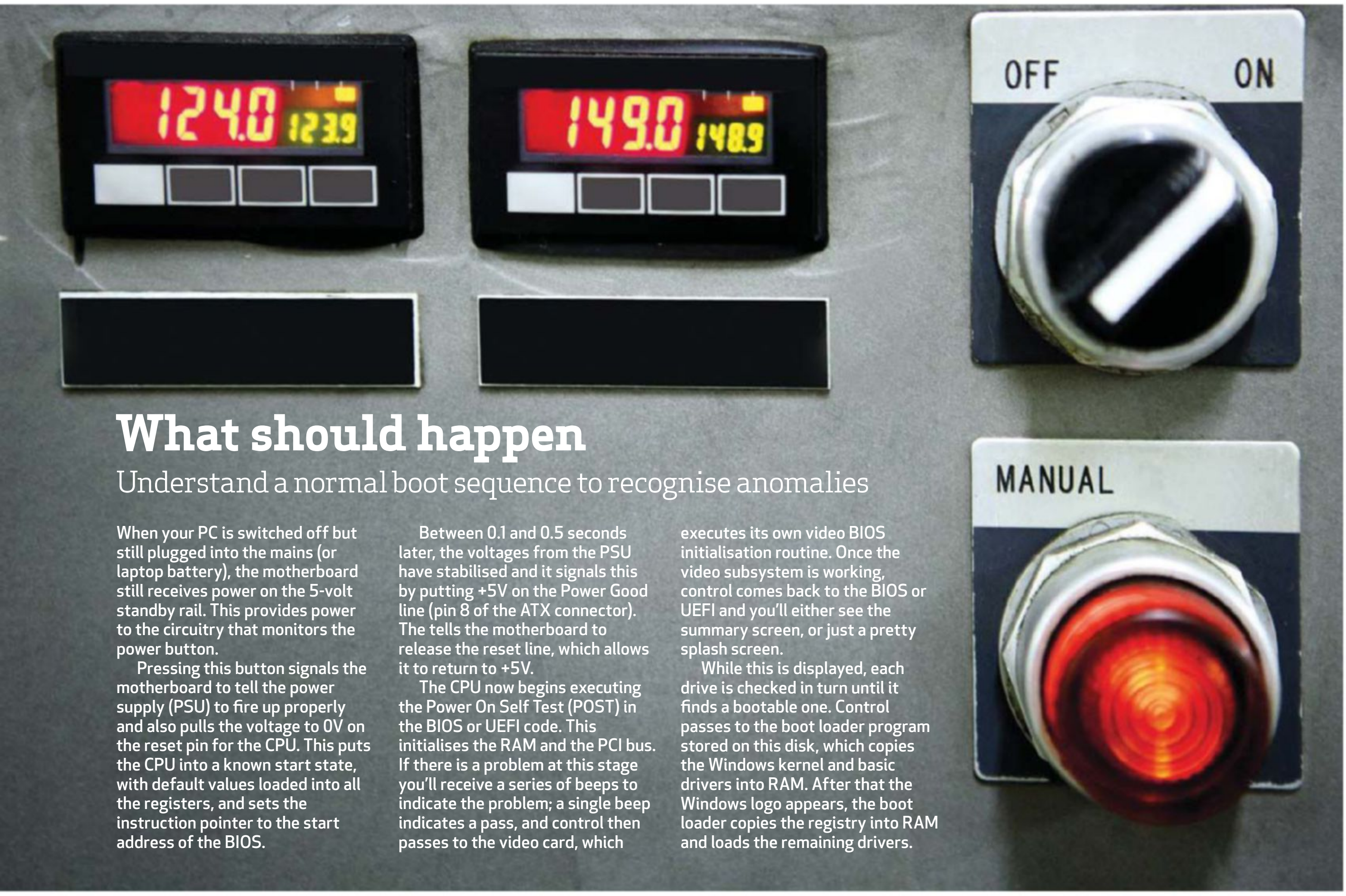
Programmers are like Neo: they don't see files and icons, they see resource handles. Memory isn't just a quantity, like the fuel in your tank; it's a collection of discrete integers and floats and strings. When you understand how the house is built, you'll know which walls you can safely remove and which will bring the ceiling down on your head.

Programming means debugging, and the mindset you need to track down a tricky bug is exactly the same as the one you need to diagnose every other computer problem. Programming is like classical music theory for computer troubleshooting. You can teach yourself to strum some chords without it, but you won't become a great musician that way.

As soon as you can write a simple program, more complicated programs lose their mystique. And if you can write even a modestly useful app or a mod for a game, then your computer itself will be demystified to a degree that is impossible to overstate. Programming is such an incredibly useful skill that it should be compulsory for all five-year-olds, never mind aspiring Tech Gurus.

Happily, programming is easier to learn now than ever. Python is a good language to learn first – it's a widely used, serious language, but it is designed to be quite readable and simple.

You can learn the basics for free in a few weekends at developers.google.com/edu/python and learnpythonthehardway.org. Don't be put off by the 'hard way' part; if you can complete a sudoku puzzle or Professor Layton and the Curious Village, you can learn Python too.



What should happen

Understand a normal boot sequence to recognise anomalies

When your PC is switched off but still plugged into the mains (or laptop battery), the motherboard still receives power on the 5-volt standby rail. This provides power to the circuitry that monitors the power button.

Pressing this button signals the motherboard to tell the power supply (PSU) to fire up properly and also pulls the voltage to 0V on the reset pin for the CPU. This puts the CPU into a known start state, with default values loaded into all the registers, and sets the instruction pointer to the start address of the BIOS.

Between 0.1 and 0.5 seconds later, the voltages from the PSU have stabilised and it signals this by putting +5V on the Power Good line (pin 8 of the ATX connector). The tells the motherboard to release the reset line, which allows it to return to +5V.

The CPU now begins executing the Power On Self Test (POST) in the BIOS or UEFI code. This initialises the RAM and the PCI bus. If there is a problem at this stage you'll receive a series of beeps to indicate the problem; a single beep indicates a pass, and control then passes to the video card, which executes its own video BIOS initialisation routine. Once the video subsystem is working, control comes back to the BIOS or UEFI and you'll either see the summary screen, or just a pretty splash screen.

While this is displayed, each drive is checked in turn until it finds a bootable one. Control passes to the boot loader program stored on this disk, which copies the Windows kernel and basic drivers into RAM. After that the Windows logo appears, the boot loader copies the registry into RAM and loads the remaining drivers.

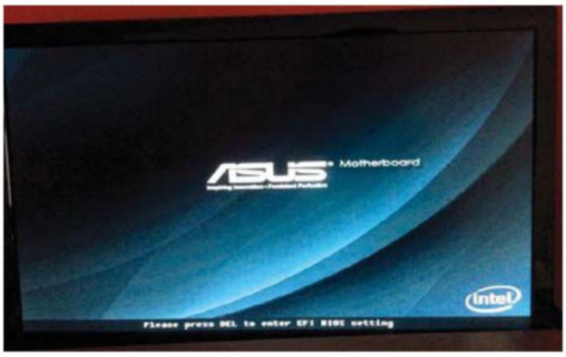
it's £400 for a basic machine and £1,000 for a fancy one. For a motherboard it's £100, although the only reason to upgrade the motherboard is when upgrade the processor as well and if you are doing that, you may as well look at a whole new machine - you'll get a much better PC, with less hassle.

HELPING OTHERS

As a Tech Guru, you have to do more than diagnose the problem. You must also consider who is asking for your help and choose the best solution. By that, I mean the best solution for *you*.

For family members, you need the quickest resolution, because they will come back to haunt you if you don't fix it on the first try. Swapping RAM modules around is a quick and safe thing to try, but reformatting and reinstalling Windows will be like cutting the head off a hydra: you may fix the original problem but three more will grow in its place, as you try to restore all the drivers for their 15-year-old printers and off-brand sound cards.

With friends and neighbours you are much less invested, so wherever possible you should recommend new kit. My experience is that this is generally what they are hoping you will do anyway; your pronouncement will be used as bargaining leverage with their spouses or parents, to justify a big spend. If you try and save them money, they will resent you for it and the next time their PC breaks, you'll be blamed for not euthanising it last time.



Please press DEL to enter EFI BIOS setting

If you can boot this far, the motherboard is probably fine

If you are fixing computers for customers, your overriding priority is to safeguard their data. Before you so much as open Device Manager, you should clone their entire hard disk onto a removable drive of your own. This will feel like a ridiculous precaution every single time, until you actually need it, whereupon it will feel like the best advice anyone has ever given you. Remember: if data is lost *for any reason* while you are sat in front of the keyboard, you will be blamed. Cloned hard disks are like save points: you can afford to be more adventurous, if you know you can hit F9 and reload.

Is that all? Are you really a Tech Guru now? Of course you are! Gurus don't have all the answers, they just know how to remain calm under fire while they look for one. They know where to look and they know the answer when they see it. You can do all these things, and all that you need now is the self-confidence to carry it off. If anyone tries to call you an expert, by all means deny it. But if they call you a guru, just smile knowingly and humbly. ■

CORSAIR
3
HOURS

Homebrew your own NAS

Jonni Bidwell shows you the DIY approach to building network attached storage

PROJECT GOAL

Set up your own NAS device
Use a RAID setup in various configurations to create your own NAS drive for storage, backup and security of files.

REQUIRES

A low-power PC
An old PC or a low-power Celeron or AMD APU system works fine.

Hard drives
Spend your cash is on storage. At least two identical drives.

Arch Linux
Arch gives you plenty of options.

As storage gets ever cheaper and appetites for data become ever more voracious, more and more people are looking to NAS (network-attached storage) to store their music, films and photos. All manner of off-the-shelf units are available from myriad manufacturers at a variety of prices. Two and four disk setups are the most common, offering a simple, secure and compact out-of-the-box solution for home storage.

It may come as no surprise that Linux is at the heart of many of these technologies, since they are just modestly specified x86 or ARM boxes belied by fancy web interfaces and easy-to-use configuration software.

Indeed, the impecunious can save a few pence by making their own NAS device. There are a few purpose-built open source NAS distributions, the most popular trio being variations on a theme: the BSD-based FreeNAS (a rewrite of an older project of the same name), NAS4Free (a continuation of the original FreeNAS code) and OpenMediaVault (a Debian-based project by the original author of FreeNAS).

These are all great projects, and will set up everything for you: from building the array to sharing your Chris de Burgh bootlegs and other files. But what if you want to set everything up yourself? Maybe you want your NAS box to double as a media centre, or use it to stream Steam games from a Windows box, or run an OwnCloud installation? Maybe you just like to be in control, especially in light of Shellshock attacks targeting web-facing NAS boxes. Without further ado, let's find out how.

Component selection

Besides disks you needn't worry too much about hardware. The machine need not be powerful, there's no need for fancy graphics and unless you're going to use ZFS, 4GB of RAM will be more than enough. HP Microservers are a popular choice, but they're not exactly the most stylish of boxes. Besides, it's fun to build it all yourself. Maybe you've already got a micro ATX case/mobo lying around, and if not you can build a cosmetically pleasing mini ITX setup without significant outlay. If the machine is going to be running 24/7, you'll probably want some quiet components. Make sure airflow is good around the drives, as they can get hot.

Controversially, we went for an AMD Kabini 5350 APU (quad core, 2.05GHz, R3 graphics). The Kabini series, aimed at high-growth low-cost markets features a miniscule 25W TDP, so overheating shouldn't be a problem. The on-chip controller natively supports only two SATA drives, but 2-port PCI-Express cards are cheap. Just make sure to get one that supports FIS-based switching (ie nothing based around the ASM1061 chip). If you prefer chipzilla, then the J1900 Celeron is a good and cheap CPU to go for. There are plenty of Mini-ITX motherboards that come with one built in. Like the AM1 boards, some allow power to be supplied by a standard 19V laptop brick.

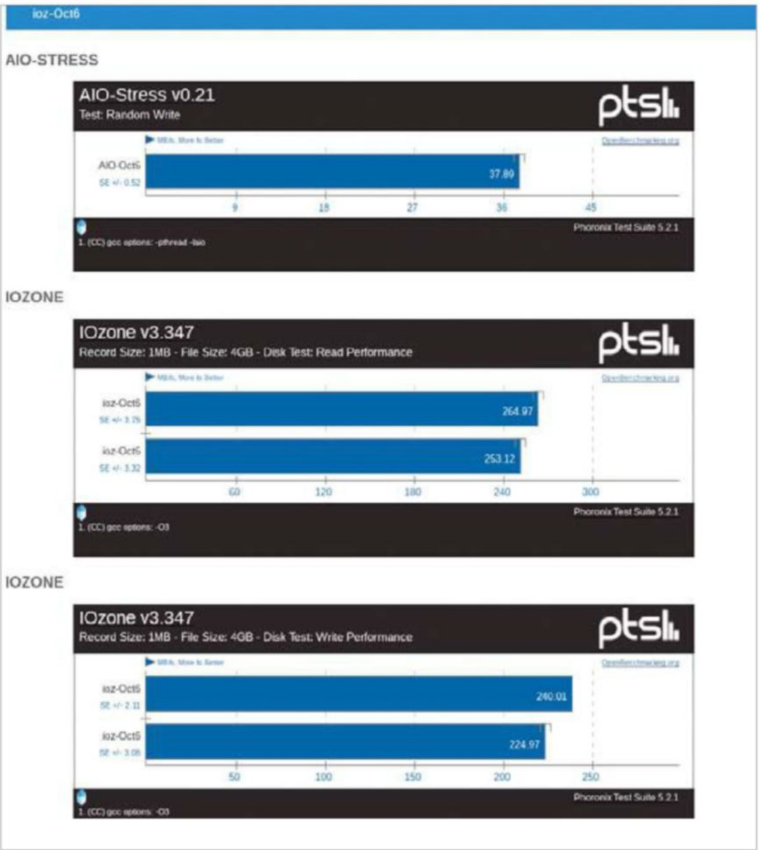
In terms of hardware, the most important part is the drives. You could make a simple storage box with a single large drive, but it's worth investing in more so that you can have some redundancy. For a RAID setup you'll want somewhere between two and six drives, and things are simpler and more efficient if they are the same size. With two drives you can have a RAID1 configuration (where one drive is a mirror image of the other), with three drives you can have RAID5 (where data and parity blocks are striped across the drives for increased performance and integrity). We've gone for four drives, mostly because the generous folks at Western Digital sent us four Red series 6TB drives.

Arranging RAID

With four drives a number of RAID configurations are possible, which we'll briefly summarise here. RAID10 is a combination of levels 1 and 0 - first you'd set up a two-disk RAID0 array (which offers no redundancy but doubles performance) and then mirror it. RAID5 is again possible, but not really recommended since if you lose one drive then the I/O intensive rebuild will greatly increase the chance of losing another – and hence all your data. RAID6 provides insurance against two drive failures, offers a small speed-up thanks to striping, and is what we opted to use in our build. We should end up with 12TB of usable space and transfer rates twice as fast as a single drive.

While it's possible to put an OS onto a separate partition on one of your RAID drives, we wouldn't recommend it: you'd have to downsize all your RAID partitions accordingly and it's generally a good idea to keep these things separated. Installing the OS inside the array is also possible, so long as the bootloader has its own partition and your initrd image has mdadm (Multiple Disk Administration) support. Again, not suitable for a storage box.

We used up all the internal bays (and SATA connections) in our wee tower, so our OS had to go on a rather nice WD Black2 USB3 hybrid drive. This is fine so long as you don't accidentally dislodge said stick while the machine is running. For a simple NAS box you're not going to want a full-blown desktop environment, so we'll start with a plain Arch Linux install. If you want to add media centre functionality further down the line then Arch will not stop you.



Our array did okay at the AIO random writes benchmark, but positively awesome at IOZone.

You can read all about installing Arch onto a USB drive here (http://bit.ly/ArchOnAUSBKey). The rest of our guide will loosely translate to other distributions too, so we'll assume you've set up a barebones install with a working internet connection. It's a good idea to set up an SSH server on your machine (for when things go wrong), and also set up a static IP. These steps are well documented elsewhere, so we'll assume you've done them. So you can unplug the keyboard and monitor and continue to build the machine remotely.

First, you'll want to partition your disks. If your drives are larger than 2.2TB, then you'll need to use a GPT partition table. Even if they're not you may as well do so anyway. The **gdisk** program is your friend here, it's part of the **gptfdisk** package on Arch:

```
# gdisk /dev/sda
```

Create a new partition by entering **n**, then press Enter again to accept that it is the first partition, press Enter again to accept the default start sector [2048]. It's a good idea to leave at least 100MB free at the end of each drive, since drives purporting to be of the same capacity often are off by a couple of cylinders. You can either do some math here to work out exactly which sector to end the partition on (multiply your drive size in terabytes by 2 to the power 40, subtract 100 times 2 to the power 20, divide that by 512 (each sector is probably 512 bytes), add 2048, bam) or you can just guestimate, for example, **+5999.9G** for something like 100 megs short of 6TB. RAID partitions ought to get the special partition type FD00, although Linux doesn't really pay attention to this anymore. Write the new partition table to the disk by entering **w**. Repeat this for all the disks you want to include in your array.

Setting up your array

The most exciting and time-consuming part of the operation is setting up the array. Much of the complexity is obviated by the mdadm abstraction layer, but make sure you get the parameters correct – the partitions you specify will be irrevocably wiped.

For example, our RAID6 array came into being by the following incantation:

```
# mdadm --create --verbose --level=6
--metadata=1.2 --chunk=256 --raid-
devices=4 /dev/md0 /dev/sda1 /dev/sdb1 /
dev/sdc1 /dev/sdd1
```

The command will run in the background for a long time (our array took 24 hours to create) and you can monitor progress by looking at the status file:

```
# cat /proc/mdstat
```

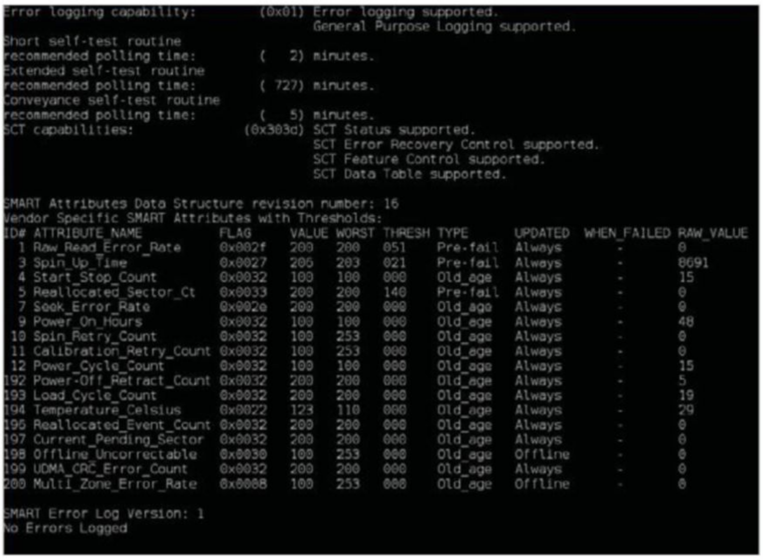
You can start using your array in degraded mode immediately, but patience is a virtue, so why not go read a book and drink several cups of tea? Or you can ponder whether 256K was a good choice for your chunk size. Chunk size refers to the size of each section of data as it is striped across drives. The default is 512K, but the optimum value depends on your hardware and use case. For larger files smaller chunks, are recommended, so that data is spread across more drives, but with only a handful of drives this logic doesn't really apply. For smaller files you should use larger chunks, but not orders of magnitude larger than the size of the files your working with. If you're determined to find the optimum, then you really have to put in some hours benchmarking your setup. Bear in mind that even if you're using Gigabit Ethernet to access your NAS, the network will most likely still be the bottleneck, so in this sense fine-tuning RAID parameters is moot. The value that you settle for is important when we initialise our filesystem though.

RAID Alert

You'll see this warning on any RAID article but we'll add it into ours anyway: RAID isn't the same as backing up! RAID is only a first line of defence, and will not protect you from accidental deletions. (And neither fire, electromagnetic pulses nor dark wizards.) If your data is really important, you must back it up off-site. This tutorial shows you how to set up software RAID and it is worth dispelling some myths on this topic.

Dedicated hardware RAID controllers are available, though at a premium. For the most part, they are not necessary either – there is a small processing cost associated with calculating parity bits, but on modern hardware this is negligible. Also hardware controllers typically use proprietary disk layouts, so if your controller fails you need to replace it with an identical one in order to get at your disks. A software RAID array can be accessed by any Linux OS via the **mdadm** command. Hardware RAID controllers can also be very fussy about SATA drive compatibility, with software RAID if the OS can see the drive, then it can RAID it.

Finally, your motherboard may claim to support various RAID configurations. This is what is known as FakeRAID, or sometimes host RAID. Despite the slightly derogatory name (the onboard controller passes all the RAID calculations to the CPU), this is still a robust setup (though usually it only supports RAID 0, 1 and 10) and will enable you to stripe your boot drive and in some cases even recover your array from the BIOS. Sometimes though, recovery requires that you go back to the safe confines of Windows.



```
Error logging capability:        (0x01) Error logging supported.
                                        General Purpose Logging supported.
Short self-test routine
recommended polling time:        (   2) minutes.
Extended self-test routine
recommended polling time:        ( 727) minutes.
Conveyance self-test routine
recommended polling time:        (   5) minutes.
SCT capabilities:              (0x303d) SCT Status supported.
                                        SCT Error Recovery Control supported.
                                        SCT Feature Control supported.
                                        SCT Data Table supported.

SMART Attributes Data Structure revision number: 16
Vendor Specific SMART Attributes with Thresholds:
ID# ATTRIBUTE_NAME          FLAG     VALUE WORST THRESH TYPE      UPDATED  WHEN_FAILED RAW_VALUE
  1 Raw_Read_Error_Rate     0x002f   200   200   051    Pre-fail  Always       -       0
  3 Spin_Up_Time            0x0027   206   203   021    Pre-fail  Always       -       8691
  4 Start_Stop_Count        0x0032   100   100   000    Old_age   Always       -       15
  5 Reallocated_Sector_Ct   0x0033   200   200   140    Pre-fail  Always       -       0
  7 Seek_Error_Rate         0x002e   200   200   000    Old_age   Always       -       0
  9 Power_On_Hours          0x0032   100   100   000    Old_age   Always       -       48
 10 Spin_Retry_Count        0x0032   100   253   000    Old_age   Always       -       0
 11 Calibration_Retry_Count 0x0032   100   253   000    Old_age   Always       -       0
 12 Power_Cycle_Count       0x0032   100   100   000    Old_age   Always       -       15
192 Power-Off_Retract_Count 0x0032   200   200   000    Old_age   Always       -       5
193 Load_Cycle_Count        0x0032   200   200   000    Old_age   Always       -       19
194 Temperature_Celsius     0x0022   123   110   000    Old_age   Always       -       29
196 Reallocated_Event_Count 0x0032   200   200   000    Old_age   Always       -       0
197 Current_Pending_Sector  0x0032   200   200   000    Old_age   Always       -       0
198 Offline_Uncorrectable   0x0030   100   253   000    Old_age   Offline      -       0
199 UDMA_CRC_Error_Count    0x0032   200   200   000    Old_age   Always       -       0
200 Multi_Zone_Error_Rate   0x0008   100   253   000    Old_age   Offline      -       0

SMART Error Log Version: 1
No Errors Logged
```

Smartmontools can use your drives' SMART data to prophesy imminent hardware problems.

You need to tell mdadm about your array so that it can be easily accessed after a reboot. You can do this by running

```
# mdadm --detail --scan >> /etc/mdadm.conf
```

which will add a line something akin to

```
ARRAY /dev/md0 metadata=1.2 name=wdarray:0 UUID=35f2b7a0:91b86477:bff71c2f:abc04162
```

to mdadm's config file.

The device node **/dev/md0** can now be treated like any other partition, albeit a massive 12TB one in our case. So let's format it in preparation for a massive dump (of data). We're going to use ext4 which is perhaps a conservative choice, but it's robust and modern. More exotic filesystems scale well to tens of drives and can manage your array independently of mdadm, but ZFS needs lots of memory (expensive ECC memory is strongly recommended) and Btrfs can cause CPU spikes. Ext4 has a couple of RAID-specific options **stride** and **stripe-width** and it's important to get these right so that RAID chunks and filesystem blocks are aligned. Stride is the number of filesystem blocks spanned by each chunk, so calculation is chunksize/blocksize. Ext4 uses 4k blocks by default (though you can use smaller ones via the **-b** option if you want), so each of our 256k chunks span 64 blocks. Stripe width is this figure multiplied by the number of data disks. In our four-disk array, each chunk is spanned across two disks and the other two are devoted to the chunk's parity, thus our stripe width is 128 blocks. If we were using RAID5, then only one disk would be a parity disk, but we're not so we formatted the array with the following:

```
# mkfs.ext4 -v -L wdarray -m 0.5 -E stride=64,stripe-width=128 /dev/md0
```

The **-m** option sets the percentage of the partition to reserve for the super-user. This defaults to 5%, which is a little high for large volumes.

Samba: shall we dance?

We'll want to add at least one user called pcfraid, and change the permissions on **/mnt/raid** to allow them to access our data silo:

```
# groupadd raidusers
# useradd -m -G raidusers -s /bin/bash pcfraid
# chown root:raidusers /mnt/raid
# chmod 775 /mnt/raid
```

Now we can start installing all the packages required.

```
# pacman -S samba
```

As well as having a system account, Samba users will need to have an entry in the **smbpasswd** file. This is achieved with:

```
# smbpasswd -a pcfraid
```

Now edit and read the file **/etc/samba/smb.conf**, there's a few things you might want to enable and disable. First, uncomment and edit the **hosts allow** line so that Samba access is restricted to the local network (eg **192.168.** or **192.168.0.**) and loopback interface only. Towards the end of the file you'll find the Share Definitions section. Add the following block to make a share for our array:

```
[raid]
  comment = PCF RAID
  path = /mnt/raid
  public = no
  valid users = pcfraid
  writable = yes
```

Later you can add more and put them in the raidusers group and set up permissions. If you want to set up a public area that doesn't require authentication, first make a directory:

```
# mkdir /mnt/raid/public
```

By default guest accesses are mapped to the unprivileged user **nobody**, so if write access is needed you'll need to **chmod 777** this directory, and uncomment the last line in the following share definition.:[public]

```
  comment = Guest area
  path = /mnt/raid/public
  public = yes
  read only = yes
  ;writable = yes
```

Alternatively, to allow write access only for users in the **raidusers** group:

```
# chown pcfraid:raidusers
# chmod 775 /mnt/raid/public
```

and then add the following inside the [public] definition:

```
  writelist = @raidusers
```

Now we can start the Samba services and test our server:

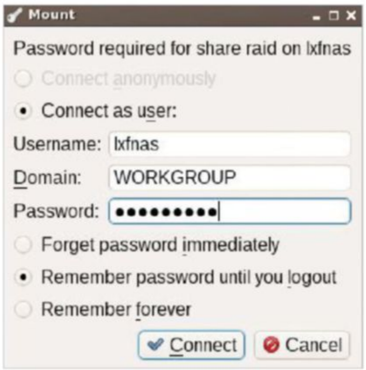
```
# systemctl start {smbd,nmbd}
```

You should be able to access the Samba shares from anywhere on your network. The nmbd service will let you look up your Samba shares using the **\\hostname** (Windows) or **smb://hostname** (Mac/Linux) URI's. But this can be temperamental and you may have better luck using your IP address here. Nautilus and Dolphin will let you browse workgroups from the Network section. Machines wanting to see SMB shares will need at least the **smbclient** package installed in order to browse and mount network shares. If you can't access your shares then good luck troubleshooting – the **testparm** command is a good place to start, it will check your **smb.conf** for anomalies. You can then set these services to start automatically by replacing **start** with **enable**.

If you want to automatically mount your server from another machine on your network then you can add an **/etc/fstab** entry akin to the following:

```
//192.168.133.225/raid  /mnt/raid     cifs
username=pcfraid, password=password 0 0
```

Storing passwords in this way is obviously not secure so only use this on machines where no one is going to pry. Also if for any reason the Samba service is not running, like the box is turned off, then startup on a machine with an fstab entry like this will be slowed down.



Password required for share raid on lxfnas

○ Connect anonymously

● Connect as user:

Username: lxfnas

Domain: WORKGROUP

Password: ●●●●●●●●●

○ Forget password immediately

● Remember password until you logout

○ Remember forever

The Qt port of PcManFM can manage SMB mounts. It won't even bother you for a password for guest shares.

Opening up to the world

Sometimes it is desirable to make your NAS accessible via the internet. This isn't something you should do lightly, and nor is it something you should do using Samba. One way is to forward port 22 on your router to your NAS, and connect via SFTP. Make sure you've locked down the SSH server, in particular the line

```
PermitRootLogin without-password
```

is a good idea. This will restrict root access to public key only, so you'll need to generate one with **ssh-keygen** and add it to the **/root/.authorized_keys** file. You could also disable root logins altogether by setting the above option to **no**, but then you'd have to do any admin tasks locally, ie plugging a keyboard and monitor into your NAS box.

Since your external IP address is likely to change you'll want to set up a dynamic DNS using a service such as DuckDNS, dyndns or no-ip. These services enable you to run a script or client program on your machine which will update the DNS mapping for your IP address. By setting up a cron job to run this periodically your machine will always be accessible by a constant domain name. Signing up to any of these services is straightforward, but DuckDNS enables you to update things by a simple script, which befitting of the Arch KISS philosophy. Follow the instructions in the box (see the bottom of the page) to get it set up.

For the most part, your RAID will take care of itself. But keep an eye on **/proc/mdstat** – an entry like [UUUU] implies that everything is working fine, if a drive fails then you will instead get an F in this list. You can also get lots of information from:

```
# mdadm --detail /dev/md0
```

Those who prefer to go for a more hands-on approach will enjoy regularly 'scrubbing' their array. (There's absolutely nothing wrong with that after all.) This will check for any inconsistencies between the data and parity blocks, and will go on to try to repair them automatically. To initiate a scrub:

```
# echo check > /sys/block/md0/md/sync_action
```

Bear in mind that this will take a while, the mdstat file will track its progress, but if you want to cancel it at any time then you'll need to run:

```
# echo idle > /sys/block/md0/md/sync_action
```

Unfortunately, we've run out of space, but remember, there's so much more you can do with your NAS, such as use it as an email server or as a convenient way to share media or stream music. ■

DuckDNS setup

You can sign up to the DuckDNS service at **www.duckdns.org**. If you are an off-grid sort, then you'll need to decide which is the lesser of these four evils and create a special account. Change to the pcfraid user and create our DuckDNS updater script:

```
# su pcfraid
$ mkdir ~/duckdns
$ cd duckdns
$ nano duck.sh
```

Enter the following, replacing the domains and token appropriately.

```
echo url=”https://www.duckdns.org/update?domains=your_domain&token=your_token&ip=” | curl -k -o ~/duckdns/duck.log -K -
```

Then make it executable and give it a test run:

```
$ chmod 700 duck.sh
$ ./duck.sh
```

You should get some output from curl, and hopefully the **duck.log** file should now contain the encouraging text **OK**. To run this automagically, you'll need to install a cron daemon, let's use the simple **cronie**

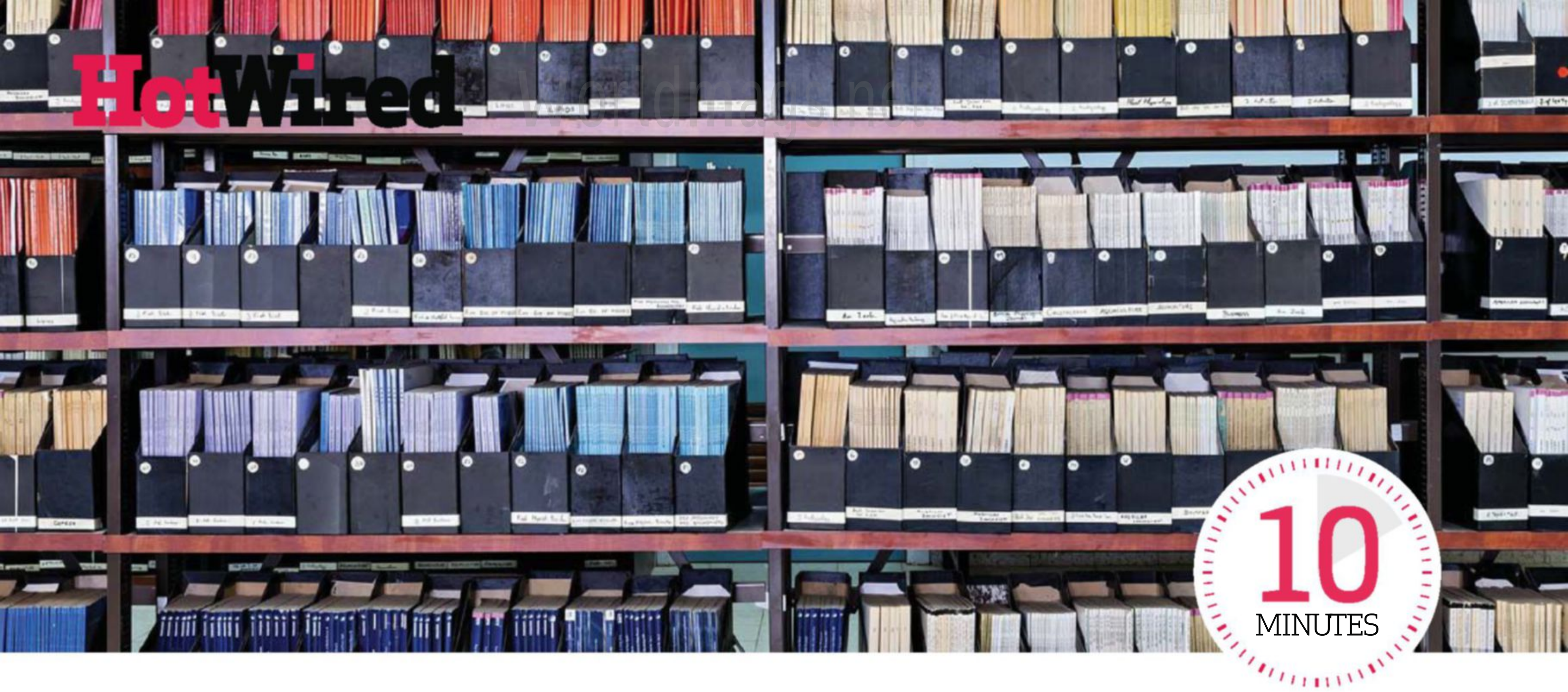
```
# pacman -S cronie
```

The next command (reverting to the **pcfraid user**) will open an empty crontab (using the nano editor so as not to induce any inevitable vi-rage):

```
$ EDITOR=nano crontab -e
```

Add the following line to run **duck.sh** every five minutes:

```
*/5 * * * * ~/duckdns/duck.sh >/dev/null 2>&1.
```



Back up with File History

Keep a running backup of your most precious data in Windows, says **Ed Ricketts**

PROJECT GOAL

Automatic backup
Use Windows' built-in features to protect your user data.

REQUIRES

Windows 8 or 8.1
Plus a USB drive, external drive, or second internal drive.

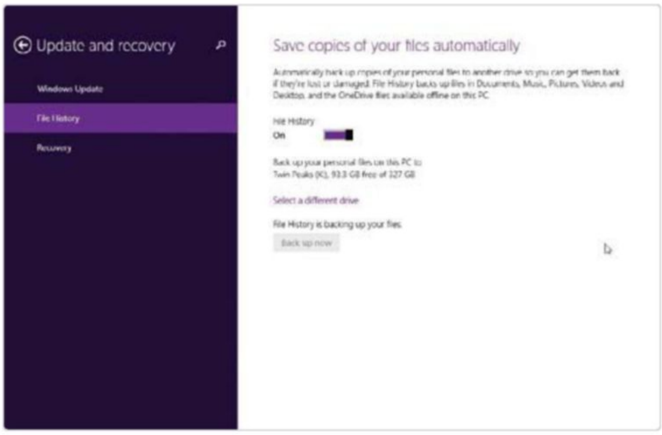
Windows 8 comes with a handy built-in utility called File History that can take a lot of the pain out of keeping a backup – even if you don't normally make any other backups regularly.

It automatically backs up the entire contents of all your Libraries (both the standard ones and any new ones you create) to an external drive or USB stick every hour, at the default setting. To restore, you can browse the backups by day and time to pinpoint the exact version.

File History is designed to work with an external drive, but you can use File Sharing to coerce it into working with a separate second internal hard drive. While Windows 7 doesn't have File History, there's a useful precursor of it that we'll also look at here.

Step-by-step: Protect your data

Set up automatic backups for all your most precious stuff



Save copies of your files automatically

Automatically back up copies of your personal files to another drive so you can get them back if they're lost or damaged. File History backs up files in Documents, Music, Pictures, Videos and Desktop, and the OneDrive files available offline on this PC.

File History
On

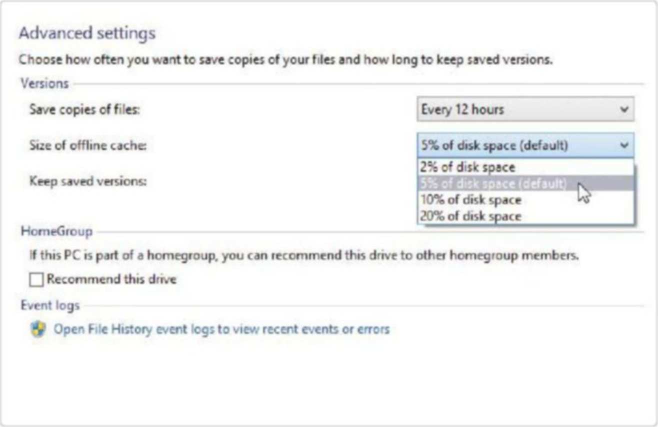
Back up your personal files on this PC to
Twin Peaks (K:), 93.3 GB free of 327 GB

Select a different drive

File History is backing up your files

1 Plug it in

By default, File History uses an external drive – this can be a hard drive or a USB stick. Search for 'file history settings' in the Windows menu or open the Control Panel to find the File History applet. Open it, then click 'Select a drive.' Choose the appropriate one and that's it – your Libraries are now being backed up automatically.



Advanced settings

Choose how often you want to save copies of your files and how long to keep saved versions.

Versions

Save copies of files: Every 12 hours

Size of offline cache: 5% of disk space (default)

Keep saved versions:

HomeGroup

If this PC is part of a homegroup, you can recommend this drive to other homegroup members.

☐ Recommend this drive

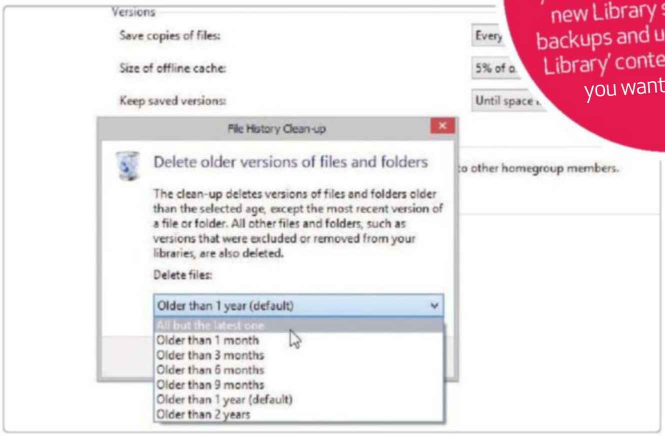
Event logs

Open File History event logs to view recent events or errors

2 When to save?

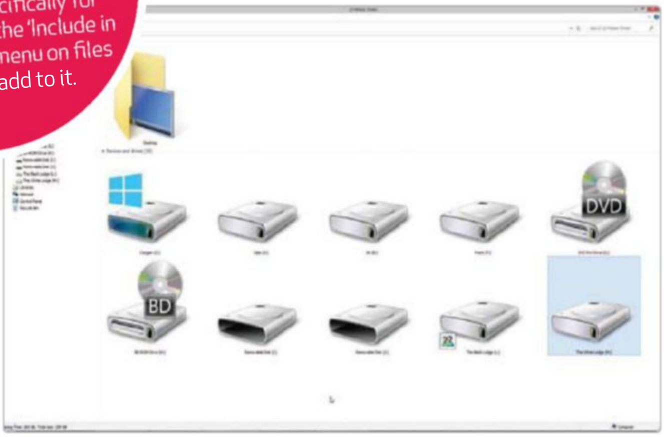
You can further tweak File History in 'Advanced settings'. Under 'Versions', you can choose how often to back up. If File History is unable to copy your data, it will still run, but temporarily saves the data to a cache on your main drive until it can reconnect. 'Size of offline cache' specifies what proportion of your main disk is used for this purpose.

TOP TIPS
CUSTOM LIBRARIES
To backup data not included in your default Libraries, make a new Library specifically for backups and use the 'Include in Library' context menu on files you want to add to it.


Versions
Save copies of files: Every
Size of offline cache: 5% of o
Keep saved versions: Until space
File History Clean-up
Delete older versions of files and folders
The clean-up deletes versions of files and folders older than the selected age, except the most recent version of a file or folder. All other files and folders, such as versions that were excluded or removed from your libraries, are also deleted.
Delete files: Older than 1 year (default)

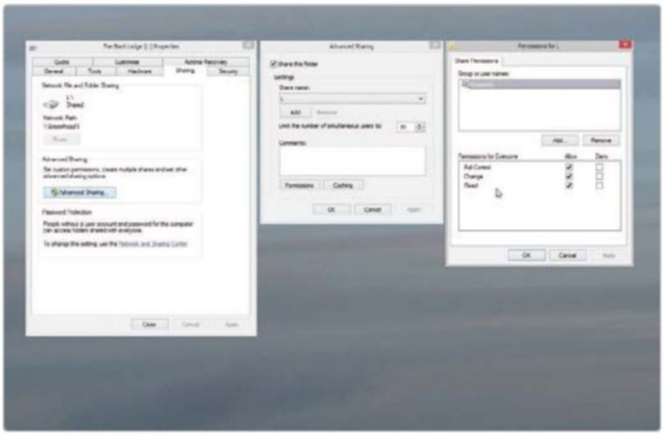
3 Old news

In 'Keep saved versions', you can specify if and when to delete older backups. For instance, if this is set to 'One month', you'll be able to see and restore backups going back a month from the current date, but no earlier. Note the 'Clean up versions' option – here you can delete all versions older than a certain date, or all but the latest.



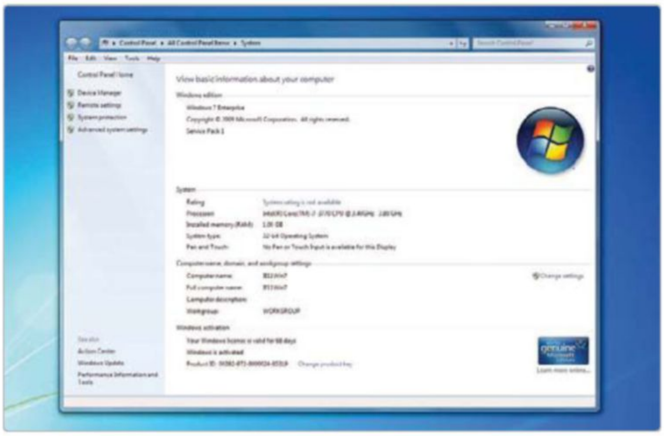
4 A different drive

As we've said, File History doesn't normally allow you to save to any internal disk drive, even an additional one to your boot disk. One easy way around this is to set up the extra drive to be shared in Windows 8 so it can essentially act as a network connection, because File History does support networks.



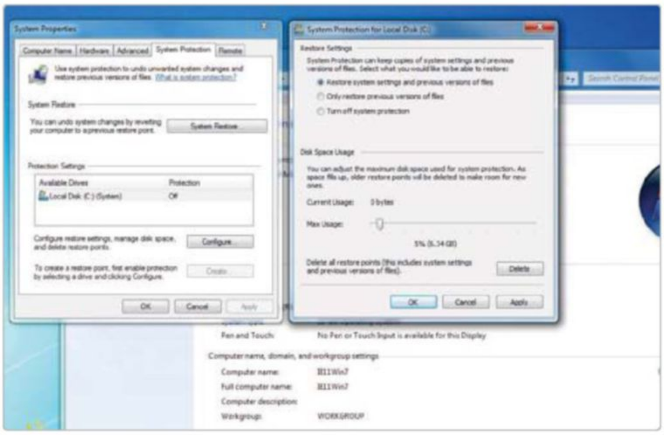
5 Sharing openly

Open the extra drive's Properties, then select the 'Sharing' tab. Click 'Advanced sharing', then tick 'Share this folder'. Click 'Permissions' and tick all the 'Allow' boxes. Close each box by clicking 'OK'. Now, back in File History click 'Add network location' rather than 'Select a drive'. Your extra internal disk will now show up as a backup destination.



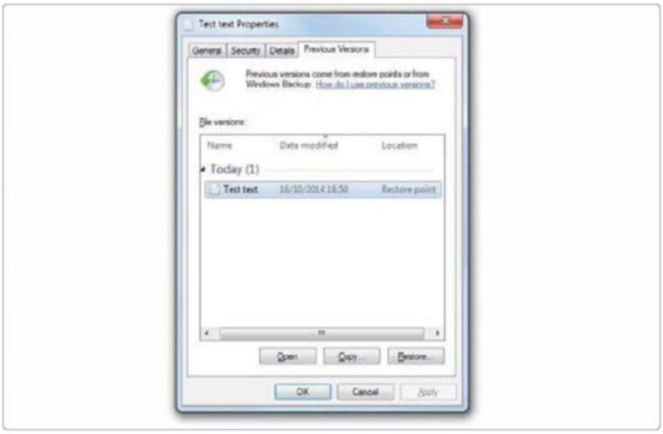
6 Backups in Windows 7

Windows 7 features a more primitive version of File History called Previous Versions. For Previous Versions to be available, you need to turn on Windows 7's System Protection feature, which takes snapshots of your drive(s) at regular intervals. First, open the Start menu in Windows 7, right-click 'Computer' and click 'Properties'.



7 Protect and survive

In the left pane, click 'System Protection'. Click the 'System Protection' tab, and then click 'Create'. Ensure your Windows drive is selected, then click 'Configure'. You can save system settings and data, or just data. Choose one then click 'OK', then 'OK' again in the System Properties box. Windows will now take regular snapshots of the drive.


Test text Properties
Previous versions come from restore points or from Windows Backup. How do I use previous versions?
File versions:

Name	Date modified	Location
Today (1)		
Test text	16/10/2014 18:50	Restore point

8 Restore a previous version

Any time you want to restore an older version of a file, right-click it and select 'Properties', then the Previous Versions tab. Provided the file has changed since the last backup, all the versions that have been saved with restore points will be in the list, and you can open it, copy it elsewhere, or restore to its original location. ■

Ask Luis

All the stuff **you** didn't know

Luis Villazon addresses more of your technical highs and woes. Keep your arms and legs inside the car at all times

REPRODUCIBLE CALAMITY
V IS FOR VERBOTEN

I know you don't like anyone using the 'V word' in the magazine so I'll try to beat around the bush a little. I recently was a Victim of a Very Vicious piece of software. It struck like a Viper and injected Virulent Venom into my Veins. I finally managed to rid myself of the Various search engine redirections and Vapid extra tabs that appeared in Chrome, but there is still one more thing to remove before I am Victorious: the Vile 'Ask Jeeves' toolbar. Whenever I try to uninstall it, it tells me to close all open Chrome windows – even though Chrome isn't running! Am I still infected?
Anthony Watkins

Yeah nice. But you're missing the point entirely. I don't mind you using the word 'virus'. What I object to is you leaping to diagnose a virus infection when you haven't got one – and this is exactly what you are doing here. You didn't have a virus, you had a browser hijack, which is to a computer virus as a hangover is to Ebola.

Browser hijacks are roughly on a par with toolbar plugins and spam emails: you didn't ask for them, you don't want them and they take up your time and energy to remove. But not much. And they don't multiply autonomously. They rely on various social engineering strategies which all basically boil down to not unticking the opt-out box somewhere.

Aaaanyway… The Ask toolbar can't uninstall without closing Chrome first. Unfortunately, as you have discovered, closing all the Chrome windows doesn't actually close Chrome. If you open Task Manager you'll see that there are one or more tasks called "Google Chrome (32-bit)". You need to close all of these before the Ask uninstaller can complete.

No, I don't know why Chrome doesn't just shut all of its own blasted processes when you close the last open window either. Doesn't make it a virus though.

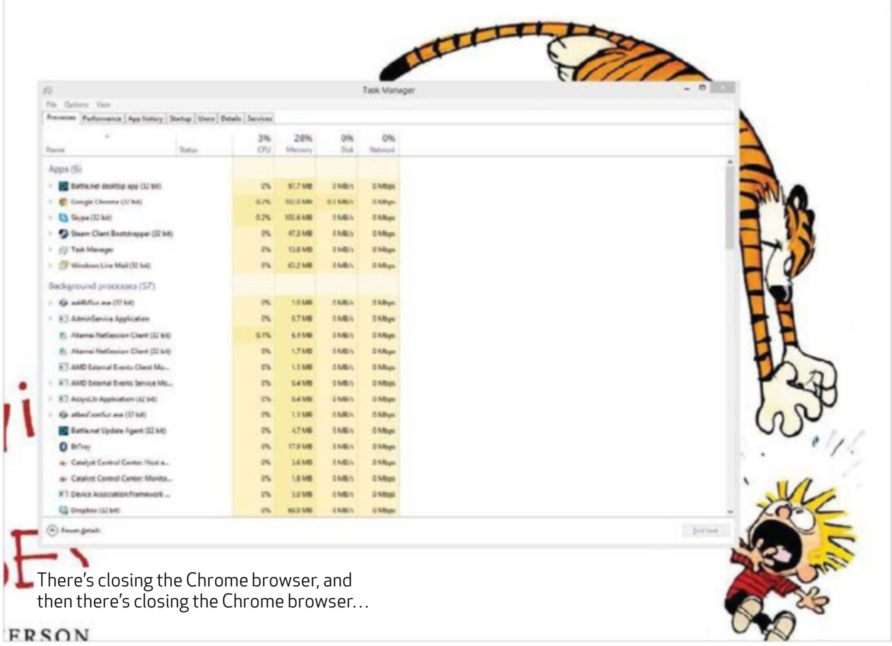
OMINOUS PORTENTS
CONVERTIBLE DRIVE

I'm looking to replace the hard disk in my somewhat oldish desktop computer, to give it a bit more pep. I've been looking on Amazon and various other sites and I notice a lot of drives seem to have their innards exposed. Are these 'naked' drives designed for laptops with sealed cases or will they work in a normal desktop case? I'm sure I've heard in the past that dust is bad for disk drives, and the inside of my case has more than enough of that to cause problems if that is true.
Keith Derby

Dust is very, very bad for hard disk platters. The read/write heads of a hard disk fly about 3 nanometers above the surface. The smallest dust particles are about 1 micron, which is 300 times bigger. In a 7,200rpm drive with 3.5-inch platters, the heads are travelling at 75mph around the outside tracks.

Now, the mass of a grain of dust is trivial compared to the momentum of the drive heads, but it can interfere with the flow of air that provides the aerodynamic lift keeping the head at the right separation. The turbulence can be enough to cause the heads to wobble in flight and crash into the surface of the platter. This gouges a big scrape in the media coating, and permanently destroys that track.

Or at least it would, if the hard disk wasn't factory-sealed into a box with just a single, highly filtered vent hole to equalise changes in atmospheric pressure. All hard disks remain sealed like this for the whole of their working life. The only time you will ever see the heads and platters is when someone destroys a disk by taking the lid off for a publicity shot. If I look at the web page for London Zoo (zsl.org, in case you were wondering) the



There's closing the Chrome browser, and then there's closing the Chrome browser…

Free technical support

Email Luis for guaranteed insults and possibly even some technical help as well.

pcfhelpline@futurenet.com
PCF Helpline, Quay House, The Ambury,
Bath BA1 1UA

The six categories of all human misery

REPRODUCIBLE CALAMITY
Things that break predictably.

RANDOM WEIRDNESS
Things that break unpredictably.

CREEPING BADNESS
Things that just get worse.

OMINOUS PORTENTS
Things that might be a problem.

SPONTANEOUS BREAKAGE
Things that definitely are.

RAINBOW CHASING
Things that could be so much better.

Hard drives don't normally look like this in real life

tigers don't appear to be enclosed either, but I'm pretty sure they are.

CREEPING BADNESS
IT GOES UP TO 11!

I built my own PC and have the latest version of Windows running on it (with all updates installed and so on). But I still see popups asking me to update to Internet Explorer 11. This seemed odd to me, so I went to Microsoft's download page and it tells me that I already have the latest version installed (I have IE 10.0.9200). How can they both be right? Is IE 11 real? Is there some reason why I would have to wait for a random pop-up to invite me to download it?
'Tank' Michlour

Internet Explorer 11 is real enough, but you are right to be suspicious. None of the major browsers use pop-ups to invite you to download the newest version. IE in particular should download automatically as part of the normal Windows Update process. The reason it hasn't (and the reason the Microsoft download page doesn't work for you) is that IE11 isn't compatible with Windows 8.0. It works with Windows 7 or 8.1, but not 8.0.

As far as I can tell, there is no technical reason for this. Microsoft has probably intentionally created a ghetto of Windows 8.0 to encourage everyone to update to 8.1 (which is free).

So why haven't you? Well I think I can guess. Windows 8.1 64-bit uses the CompareExchange128 instruction, which is a way of swapping two 16-byte chunks of memory in a single operation. That instruction isn't supported on a few of the super-old AMD processors, such as the Athlon 64 X2. If you're running Win 8 64-bit and your PC uses one of those processors, then you are stuck with Win 8.0 – and by extension, IE 10. In which case, you have three options. The most medieval is to keep your 10-year-old CPU and downgrade to Win 7 64-bit. Almost as bad would be to install the 32-bit version of 8.1. Or you could take this as a sign that you should build another PC, but this time with components that post-date the reign of Pope John Paul II.

"IN A 7,200RPM HARD DRIVE WITH 3.5-INCH PLATTERS, THE HEADS ARE TRAVELLING AT 75MPH"

RAINBOW CHASING
CAPTAIN'S LOG

At work we have some old servers running Windows NT that do some environmental systems monitoring for some of our equipment. These servers have log files that record the values from some sensors and any remote queries that have been made by our engineers. One of my 'morning coffee tasks' is to clear out those log files because if they get too big, the system crashes. I can't delete the files completely – I have to open each one, hit Ctrl+A, Ctrl+X, Ctrl+S, and exit. Is there a way to automate this?
Amun Habekost

You can do this from the command line or a batch file. Something like

```
FOR /R N:\FolderName %%f IN (*.LOG) DO TYPE NUL > %%f
```

ought to do it. Replace N:\FolderName with the networked drive letter and path, and save that in a text file as

YOU ASKED!

FAQ

Father.io

Bless me Father, for I have fragged

What is this?
It's an augmented reality first person shooter game.

What's an augmented reality game?
An ARG overlays virtual game elements on the physical world around us. *Ingress* is an ARG game. You walk around in the real world and when your phone's GPS says you are in the right spot you can interact with the virtual portals in the game.

How is Father.io different?
It's an FPS. In *Ingress*, players don't interact with each other directly, they just capture the other faction's portals. Father.io will make this a good deal more personal. Your phone becomes your gun and you 'kill' other players by pointing the phone at them and lining them up on your crosshairs.

Surely GPS isn't accurate enough for that?
It isn't. That why Father.io uses a hardware attachment (called a 'Trigr') that clips onto the front of your phone to handle the 'Did you hit or not?' part of the game. This requires line of sight to the other player, making it feasible to take cover behind cars, pillars and possibly even human hostages.

How does the Trigr work?
It seems to have a lens on the front, so it's possible that it uses a laser rangefinder to measure the distance to the player and compares that with the known position of the player in the game. It's likely that the hit boxes will be much more generous than a normal FPS.

Won't this spark actual gun battles?
The system automatically locks out games played near government buildings or in high-crime areas.

When is it out?
No word yet. The best you can do is sign up to be notified of the beta.

Read more at: http://father.io

deletelogs.bat on your desktop. If there are logs in more than one folder, you'll need a **FOR** command for each folder.

But the bigger picture, of course, is that your company is using ancient servers connected to dreadful logging software and this solution isn't going to help with that. The way to convince your company to upgrade is to make clearing the log files *harder*, not easier. That way, you can point to the time it takes you to clear them every day, multiply it by your salary and show that over a year they would save money by installing new hardware. For that you need to delete those logs as slowly as possible. I'd suggest disabling autorepeat on your keyboard and backspacing each character one at a time. This will also let you add in the wear and tear of your keyboard as part of the potential cost savings.

"IF YOU WERE GOING TO CARRY ON PLAYING A 12-YEAR-OLD GAME, WHY DID YOU NEED TO UPGRADE?"

OMINOUS PORTENTS
THOSE BLINKING HACKERS

How can I tell if someone is hacking into my Wi-Fi? I have a TalkTalk router that was recently replaced when I upgraded to fibre broadband and I have seen some suspicious activity. The Wi-Fi light blinks when none of our PCs are on, for example. If I look at the DHCP list on the advanced page, it shows some computers that I don't recognise. Should I be worried?
Austin Blake

Probably not, but this level of caution is sensible. Check you are using WPA or WPA2 security on the Wireless Summary page. WEP is the Wi-Fi equivalent of the lock on the bathroom door: it won't keep out anyone that doesn't respect your privacy already. The default for most routers these days is WPA/WPA2 mixed mode, which provides decent security and still allows older devices to connect. If you are already using this, change the password, to be doubly sure, but I'm pretty sure you're fine.

Of course, even completely open Wi-Fi isn't necessarily a cause for concern. Otherwise, how would cafes and shops be able to offer it? Letting someone on your Wi-Fi only guarantees them access to your internet connection and your local area network. It doesn't let them onto any of your actual computers unless you have enabled guest accounts, have easy-to-guess passwords, or are running unpatched versions of Windows with security vulnerabilities.

Probably the easiest way for a hacker to get into your system is to access the router configuration page and change the DNS records so that google.co.uk actually points to a webpage of their choosing that downloads a trojan to your desktop. That's why it's at least as important to change the admin password on your router, as it is to change the WiFi password. Leaving it as 'admin' is just silly.

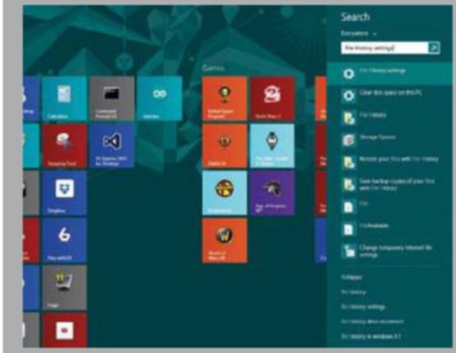
CREEPING BADNESS
TEACHING A NEW DOG OLD TRICKS

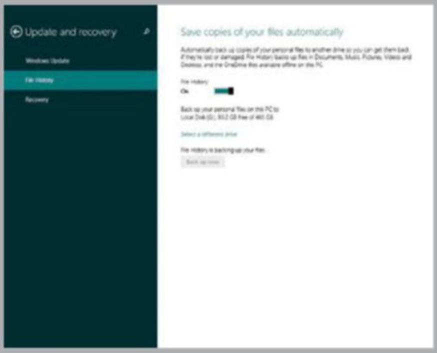
I have stripped out my ancient PC and completely rebuilt it from the ground up, to finally make the jump from XP to Windows 8. Just about the only thing I have kept is the case and the keyboard. This move was partly inspired by your recent comments about not getting too many versions of Windows behind. When Win 10 comes out next year, I would have been four versions behind!

In general I am very pleased with the new hardware and slowly getting to grips with Win 8 and its tiles. But there is one thing I didn't expect. Games that used to run fine on my old PC actually run slower on the new one. *Crusader Stronghold*, for example, is about ten times slower! How could this be possible?
Steve Banbury

Way to completely miss the point, Steve! If you were going to carry on playing a 12-year-old game, why did you need to upgrade? A PC isn't a thing, it's just a way to run an operating system. Windows isn't a thing, it's just a way to run an application.

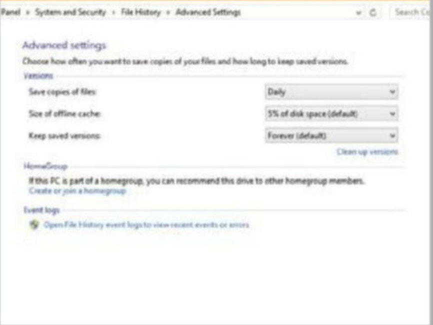
'Time Machine' for Windows
Automatic timed backups without the faff

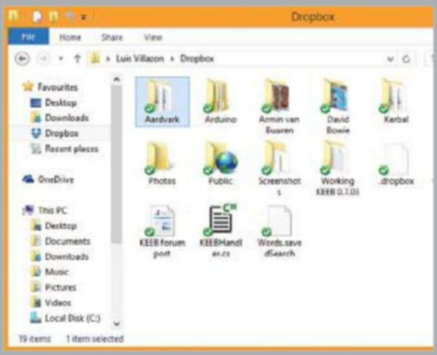




1 Activate
Windows has included an automatic backup feature for ages, but most people don't know about it. It's called File History and you can find it by simply searching for 'file history' in the search bar. If you have an external USB or networked hard disk available you can assign it to File History.

2 Refine
File History won't backup system files. It's only for the Documents, Music, Pictures, Videos and Desktop folders, as well as any files from OneDrive that are synced on your PC. If you want files from elsewhere included, you'll need to copy or move them first. But you can exclude folders if you want.





3 Recover
By default File History backs up once an hour, but you can change this if you want, via Advanced settings. To restore, search for 'restore your files' and enter the file name or browse through the backup folder. To restore to a different location, right-click the Restore button and choose Restore To.

4 Alternative
A different approach is to create a symbolic link to a folder in your Dropbox or OneDrive folder. From the command prompt, type **mklink /D "c:\users\<your user name>\dropbox\documents" "c:\users\<your user name>\documents"**. This will automatically sync every file to Dropbox.

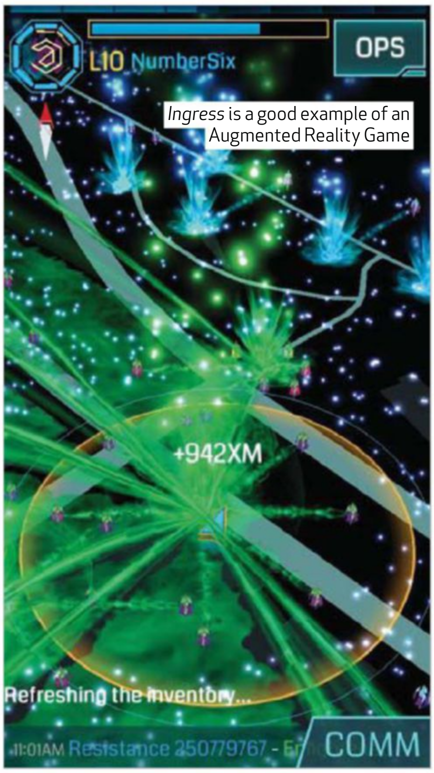
A new version of *Crusader Stronghold* is available - it's apparently in HD

The application *is* the thing. You start with the software you want to run and you work backwards from that. If you want to run *Crusader Stronghold* – a game that requires 64MB of RAM and a Pentium II processor – Windows XP is perfectly fine. Just disconnect your PC from the internet, so you don't need to worry about security flaws, and go wild. I've got a BBC Micro Model B in the loft, and if I ever want to play the original *Elite* again, that's what I'll use to play it on. But I won't because *Elite* is so old now that I would just sully its memory by revisiting it.

The same goes for *Crusader Stronghold*. You could rebuild your old PC by simply getting another case and keyboard and guarantee that all your old games would work just like they used to. But please listen to me: *there are better games out there now!* It is your responsibility – your *duty* – to go and find them and then play them on your new PC.

With that sorted, and purely as an academic exercise, we can consider why *Crusader Stronghold* might run so slowly on Win 8. I think the reason lies with DirectX 11. This emulates the function calls of older versions to provide backwards compatibility with older games, but there seems to be a problem with DirectX 7 calls, which is what *Crusader Stronghold* uses. One possible workaround would be to use the DirectX wrapper that comes with Wine. Wine is a Windows emulator for Linux, but you can download just the DirectX wrapper, compiled for Windows, at www.nongnu.org/wined3d. If you put this in the game folder for your DirectX 7 games, it will override the Win 8 DLLs and you should get much better frame rates.

Or you would, if you actually wanted to play *Crusader Stronghold*. Which, remember, you don't.



Ingress is a good example of an Augmented Reality Game

L10 NumberSix
OPS
+942XM
Refreshing the inventory...
Resistance 250779767
COMM

RAINBOW CHASING

ALL YOUR PORTAL ARE BELONG TO US

I've been using augmented reality games to make my morning run less boring. I played *Zombies Run!* for a while on my iPod and recently I've been experimenting with *Ingress*. My normal running route takes me up a steep hill in a fairly out-of-the-way area and there is an *Ingress* portal on the trig point at the top.

I'd like to make a field that covers most of my town, but the portals in town get taken down too quickly for me to control all three points of the triangle for long enough to create the links between them. I have an NGM Explorer phone, which is waterproof, so my idea is to hide my phone near the trig point and leave it

FLASHBACK

What Luis said...

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Dave finds DiRT 2 too fast and furious
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GET MORE FROM YOUR RIG
THERE'S MORE...
What next for PC Audio?
Jon Carmack & Sid Meier interview
RAM drives: better than SSDs?

5 years ago (PCF235)

About clock speeds

Let's talk about Heinrich Hertz. Born in 1857 in Hamburg, the son of a barrister, he studied Sanskrit in a gymnasium (no, really!) and developed a graphical means of determining the properties of moist air. And then he died. At age 36. Luckily, as well as the properties of moist air he did quite a bit of work on electromagnetism, so the IEC used his name as the SI unit for frequency. In doing so, they gave science a great new pun, too.

But it's still spelled *Hertz*, which is my point. There's no such thing as a 'hert'.

10 years ago (PCF169)

About joystick support

Joystick support in *Planetside* is essentially zero. I have wasted oh sooo many evenings trying to get even a simple two-button, analogue stick to work reliably and it is as unrewarding as sewing an extra belly button on an angry koala. Theoretically, fixing this glaring deficit is on the developers' to-do list, but I suspect if they haven't done it by now, they never will. *[They never did – Ed]*

15 years ago (PCF104)

About earwigs in your keyboard

I think I would err on the side of not de-wigging. Earwigs are quite good insulators, so the risk of a short-circuit is fairly small, and unless your keyboard contains a flourishing ecosystem of other little beasties, the earwig has probably climbed out by now.

Windows 8 still has the potential to upset some of our readers...

there. Then use my iPad to capture the portals in town and then remotely capture the portal on the hill by using some software that 'hacks' into my phone. Good idea? Bad idea? What software to you suggest?
Dante Miglia

Terrible idea. First, and most importantly, it's cheating. If you log in to the same *Ingress* account on two devices in widely separated locations, you will be banned. Using two accounts, while harder to catch, is also against the TOS and could result in a ban if somebody reports you.

Second, it's technically difficult to do. You would essentially have to root-kit your phone with something that polls a web server for instructions. This means that the phone must be transmitting nearly constantly, which creates a narrow window of opportunity before your battery goes flat.

Third, your field will only last for as long as it takes for someone to hack one of the portals in town, which doesn't sound like it would be very long. Fourth, a much easier way to achieve the same thing is to recruit a friend to play with you. *Ingress* is specifically set up to encourage social play; if you are looking for ways to thwart this, maybe *Ingress* isn't for you.

RAINBOW CHASING
DONER KEBABBED

I'm developing a web-based tool for planning interplanetary intercepts in *Kerbal Space Program*. I'd like to include a 'donate' button to help cover my hosting costs but I don't want to appear pushy and put people off from using the tool. I know you play the game, so can you tell me how much you think is a good amount to ask – or should I just put 'Donate!' on the button and let people choose?
Tany Nkosi

Web-based tools that show the phase angles for interplanetary transfers already exist – http://ksp.olex.biz is probably the most well-known and this already has a donate button at the bottom. I don't find this site very useful though, because knowing the phase angle and being able to accurately set it up in the game are two very different things. What I want is a web tool that lets me plan encounters and then have it interface directly with the game and create the manoeuvre node for me. If you have that, I'll happily bung some money your way.

Donate buttons that work for me are the ones that are simple and specific; the generic yellow PayPal button is too easy to tune out. I want an attractive, friendly red button that says "Donate $3". If you put another button, in a more orangey shade underneath that says "Donate $1", you'll catch the ultra-cheapskates and at the same time goad most people to opt for the $3 option.

But this is just my completely unqualified opinion. If you really want to know what works, you need to do what is known as A/B testing. This uses two versions of your site and tracks which version works better. Optimizely.com is a tool for automating this; they charge £12 a month for up to 2,000 visitors per month, but there is a one-month free trial.

CREEPING BADNESS
EVERYTHING NEW IS TERRIBLE!

I hate Windows 8.1. There, I said it! I don't see the point of the Metro tiles and the interface is confusing and ugly. On top of that, everything runs much more slowly than Windows 7 on my machine. I only recently upgraded and already I'm regretting it. What's the easiest way to get my Start menu back to how it was? And how can I get rid of the slowdown?
Maarten Lech

I'm lucky: I don't really have any choice with operating systems. Whenever a new one comes out, I'm obliged to have at least one machine running it, just so I can write about it. I normally keep the older ones hanging around as well, going back at least a few versions, but the newest version always ends up being the one I actually use. This forced migration stops me from getting tunnel vision about which version of this or that is better than the other thing, and so on.

Here's the truth: they are all terrible. Operating systems are going through their uncanny valley at the moment. They have advanced to the point where we can glimpse the Elysian Fields of perfect man-machine symbiosis, but that just makes us even more dissatisfied with what we have now. Windows 8.1 is confusing and ugly, yes. But then so is Windows 7; it just happens to be an ugly confusion you are used to.

If you want your Start menu back, the easiest thing to do is to wait for Windows 10, which will bring back a sort-of hybrid version of it – or install Classic Shell from www.classicshell.net. You can use the occasion to justify buying a new PC, which will also fix your slowdown problems. I will spare your blushes by omitting your system specs here, but these are your problem, not the Metro interface. ■

STATS KNOW-IT-ALL?

Quiz

1. How do you change settings in Windows 7?
a) at the command line
b) using third party apps
c) you can't
d) Control Panel

2. How do you change settings in Windows 8?
a) Control Panel
b) PC Settings
c) either
d) you can't

3. How will you change settings in Windows 10?
a) Control Panel
b) PC Settings
c) either
d) just PC Settings

4. What's apparently wrong with Control Panel?
a) too confusing
b) not confusing enough
c) duplicates PC Settings
d) it lost the toss

5. What will happen to Control Panel later on?
a) it has gone forever
b) it will cost extra
c) it will come back in 10.1
d) it will just be harder to find

Answers: 1d, 2c, 3d, 4a&c, 5a or possibly c

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THE MONTH IN NUMBERS

$1.16 billion

The amount Google has paid for a 60-year lease on NASA's Moffett Federal Airfield in California. The search giant plans to use the huge hangars and runways for research under its Planetary Ventures LLC branch, which is an elaborate way of saying it's building an evil lair.

$5,000

The cost of a gold Apple iWatch. The luxurious wrist adornment will be ten times as expensive as a stainless steel variant. Mike from down the pub reckons he can get us one for £20 and a pack of Hob Nobs, mind.

$5,500

...and for just $500 more you can build your own supercomputer. Storage company Western Digital used Amazon cores to create a 729 teraflop, 71,000-core ubermachine to stress-test its latest hard drive designs. Can we still make jokes about *Crysis*?

99

The number of iPhones a Chinese man used to propose to his girlfriend. The unnamed technology worker splashed out RMB 500,000 (£52,000) to buy the ubiquitous smartphones, which he then arranged in a heart-shape before getting down on one knee. She said no, of course. Mainly because it was just a weird thing to do.

$2 billion

The amount that music streaming service Spotify has paid artists since it launched in 2008. The firm has previously attracted flak for the low payments dished out per track, but according to CEO Daniel Ek it paid out a billion in the last year alone. Mostly to The Beatles and Led Zeppelin, we reckon.

1714
Ye Olde PC Format
Ye Olde Format
Hear ye Hear ye

PC Format has a mole. A man wedged inside the games industry's nether regions. A man rendered so hideously paranoid by a life spent playing sub-standard PS2 ports that he won't even let us edit his copy. These are his troubled thoughts…

THE VOICE OF REASON

This used to be all fields

As you get older, birthdays and anniversaries become more and more spaced out. You start with your first, second and third birthdays, but, honestly, who celebrates turning eight? It's the age when you're at your most pathetic and useless. It was a bit of a surprise, then, to get an email from *PC Format*'s head honcho informing me that the magazine is celebrating its 300th issue.

It seems like only yesterday that *PC Format* launched, even though it was 1714. It was an eventful time: the Ottoman-Venetian War began, the Battle of Gangut ravaged the Russian and Swedish navies, and *Lovejoy* and *Deadwood* star Ian McShane was born. In computing terms very little happened for at least 236 years, but nevertheless *PC Format* – complete with a crude drawing of a syphilis-infected prostitute on the front cover – was sold alongside *The Daily Courant* and *Nuts*, which at the time was dedicated to the hard fruit rather than hard boobs.

Initially the magazine was met with scepticism. At the time most people couldn't read, so it ended up being used as bog roll, firewood and a source of sustenance. The latter was so prevalent that in 1776 the decision was made to lace the pages with arsenic to prevent the magazine being eaten, which led to the poisoning of some 20,000 Brits.

I was first invited to work for the magazine in 1823. At the time I was King of Britain, and also had a sideline in trapping and cooking pustulent rats – free mayo! My first move on the magazine was to hang, draw and quarter the editor and writers – a wise move which ended up saving the magazine four florins a year. Various body parts were cover-mounted, too, as a subtle reminder to the denizens not to become games journalists.

The centuries rolled onwards. The outbreak of the Great War coincided with PC Format's 200th anniversary, an event which was celebrated with a ceasefire on Christmas Day. German and British forces gathered on the Somme to discuss the graphics card buyers' guide. The Second World War was made a lot easier for the Allies thanks to *PC Format*'s in-depth guide to *Wolfenstein 3D*, and we later printed a guide to overclocking the Enigma machine.

War was followed by love, and issue 253 was created during the notorious *PC Format* love-in of 1967. The resulting magazine made little to no sense due to the amount of drugs the team consumed, instead consisting of a series of abstract, bodily-fluid-stained drawings of Barbra Streisand straddling a yurt while blowing furiously on an alpine horn.

Finally, in the mid-90s, *PC Format* really got going. It was the heyday of home computing, and every single thing the magazine had predicted came to be – apart from the 'electricity' thing envisioned by guest writer Benjamin Franklin in the 1788 issue. Stick with us, dear reader, and we'll guide you through the next 300 years before they've even happened. ■

Illustrator Kevin February

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